THE INDIAN FORESTER

(FOUNDED IN 1875)

VOL. 126 DECEMBER 2000 NO. 12

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ISSN 0019-4816
R.N.I. No. 4839/57

THE INDIAN FORESTER

Volume 126 **No. 12**

DECEMBER, 2000

FRONT COVER

MANGROVE RESEARCH PLOT, WIMBERLYGUNJ (SOUTH ANDAMAN)

Photo - Rajesh

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THE
INDIAN FORESTER
DECEMBER, 2000

EDITORIAL

We have the pleasure of announcing the Brandis, Schlich, S.K. Seth, Chaturvedi and Indian Forester Prizes for the year 1999 to the following recipients to whom we offer our heartiest congratulations :

Brandis Prize

1.	S/Shri Ashok Kumar and K. Gurumurthi	-	Effect of *Frankia* on growth and nodulation in *Casuarina equisetifolia*. (May, 1999)
2.	S/Shri K. Singh and J.S.P. Yadav	-	Effect of Soil Salinity and Sodicity on seedlings growth and Mineral Composition of *Pongamia pinnata*. (June, 1999)
3.	S/Shri N.V. Singh, R.C. Sharma and C.B. Chhimwal	-	Evolution of Genetically superior new clones of Poplar (*Populus deltoides* for Tarai Region. (March, 1999)
4.	S/Shri S.S. Katewa and Rajesh Sharma	-	Species Composition, Life Forms and Biological Spectrum of the Watershed Areas of South Rajasthan. (July, 1999)
5.	Shri Krishna Chandra	-	Cover Photo. (August, 1999)

Schlich Prize

1.	Shri S.S. Garbyal	-	'Jhuming' (Shifting Cultivation) in Mizoram (India) and New Land Use Policy - How far it has succeeded in containing this primitive agriculture practice. (February, 1999)

S.K. Seth Prize

1.	S/Shri S.A. Abbasi and S. Vinithan	-	Ecological impacts of *Eucalyptus tereticornis - globulus* (*Eucalyptus* hybrid) plantation in a Mining Area. (February, 1999)
2.	Shri M.H.A. Shaikh	-	Ecological Perspective on Poverty Alleviation. (July, 1999)

Chaturvedi Prize

1.	Shri S.S. Bist	-	A Critical review of the schedules of the Wildlife (Protection) Act, 1972 and their Amendments. (October, 1999).
2.	S/Shri H.S. Singh and V.C. Soni	-	Status of Wildlife in Wild Ass Sanctuary (Little Rann of Kutch, Gujarat State, India) (October, 1999).

Indian Forester Prize

1.	Shri S.K. Sharma	-	Jackal as Potential Destroyer of *Butea monosperma* in Nature. (April, 1999)

G.S. Rawat
Hony. Editor

CARBON SEQUESTRATION THROUGH FARM FORESTRY : CASE FROM INDIA

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Introduction

There is growing international concern over the increase of carbon in the form of Carbon dioxide (CO_2) in the atmosphere over the past few decades. Forests constitute both a sink and a source of atmospheric CO_2. Managing forests in order to retain and increase their stored carbon will help reduce the rate of increase of CO_2 and stabilize atmospheric concentrations. Another crucial component could be the expansion of the area and/or biomass and soil carbon density of plantations on both forest and non-forest lands, thereby increasing storage of carbon in durable wood products. Forestation means increasing the amount of carbon stored in vegetation (living above and below-ground), dead organic matter, and medium- and long-term wood products (Watson, 1996). Among the important measures for forestation is Farm Forestry.

In developing countries like India, the potential land area available for the implementation of forest management options for carbon conservation and sequestration is constrained by socio-economic circumstances. However, Farm Forestry, which involves the growth and management of trees on private farm lands for the purpose of supply of wood and non-wood products, provides a balanced mix of economic, social and environmental outcomes. Of the 80% potential that the tropics possess to conserve and sequester carbon, Forestation and Agro Forestry/ Farm Forestry account for 50%. The remaining 50% are due to natural and assisted regeneration and slowing deforestation. Also the scenarios developed for the annual rates of carbon conservation and sequestration from these different activities show that carbon savings from slowed deforestation and regeneration initially are highest but later plantations sequester practically identical amounts as they reach maximum carbon accretion (Watson, 1996).

Social and Policy dimensions of Farm Forestry

Farm Forestry compares favourably to Reforestation or Afforestation activities not only in terms of utilizing substantial amounts of atmospheric carbon but costs. People's involvement in Farm Forestry is a major factor containing costs and keeping the Farm Forestry costs at a fraction of that of creating *de novo* forests on forest blanks

* U.P. Forest Department, Lucknow (U.P.).

or on degraded forests sites. According to the World Bank estimates for costs incurred under Farm Forestry during World Bank financed Social Forestry Projects for different Indian States, the costs of raising plantations by the State are five times more than the costs incurred in Farm Forestry plantations.

Carbon sequestration undertaken under Farm Forestry is merely a by-product of other land-use goals such as timber production, soil amelioration, environmental conservation and commercial considerations. While the policies related to expanding carbon sinks, need to be consistent with the larger land-use goals, modifying current management practices under Farm Forestry to reflect a new dimension of Carbon sequestration adds to the existing multipurpose land-use policy. This form of Carbon sequestration can also be used as a first line instrument of policy as Farm Forestry provides gainful employment to large numbers of people without causing large scale movements of labour to remote areas to undertake large scale afforestation.

Farm Forestry can be linked to agricultural development and growth of small wood based industries like small plywood units and saw mills. In a developing country scenario of low employment and low per capita income, Farm Forestry is a major instrument of increasing incomes to local people. Unlike traditional Carbon sequestration techniques, Farm Forestry has the potential of being presented by policy makers as a primary instrument a people's welfare and industrial growth. Indeed, Carbon sequestration through Farm Forestry is perhaps a highly desirable and cost effective way in high population scarce land availability scenario as is existing in countries like India.

Farm Forestry in the State of Uttar Pradesh, India

The Farm Forestry programme in Uttar Pradesh could be looked at in different contexts namely the extent of the programme, the profile of the farmers, and factors that have contributed to the success of the programme.

Extent : A comparison of the numbers of trees existing in traditional forest areas to numbers of trees being planted outside forest areas is particularly valuable to developing countries like India where extending forest area beyond its current limits is difficult. Further, the only possibility for increasing land under tree-cover is planting in non-forest areas and Farm Forestry is perhaps the best method in such cases.

The role of trees planted outside the traditional forest areas is considerable and this can be best judged when the case of Uttar Pradesh is considered. The total land area in UP is 29.4 million hectares (Mha) of which nearly 5.2 Mha is forest land (Anon., 1998). A total of 17.2 Mha is under cultivation (Anon., 1996). With a population of 139.1 million, U.P. is the most populous State in India. In addition to this large human population, the State has a huge cattle population of around 6.6 million (Anon., 1996). The per capita income of the State is below the national average and is among the lowest in the country.

Of the total forest land of 5.2 Mha in UP, the actual forest cover is 3.4 Mha (Anon., 1998) and good density forest cover is limited to 2.3 Mha. The good density

natural forests are known to have 200 to 1000 trees per hectare. The number of trees per ha in Indian forests is seen to vary with the average age of trees per hectare, and the species composition of the forest. Thus, for the purpose of a broad estimate, 300 trees per hectare have been taken as an average for good forests in U.P. At this rate, the existing good forests of U.P. State have approximately 689.07 million trees.

On the other hand, between 1979-1994, 1906.8 million trees had been planted by farmers in U.P. (Anon., 1992; 1993; 1994). Table 2 provides the year-wise break-up. Based on a survival percentage of 80 (Anon., 1992), the surviving trees work out to be 1525.44 million which converts into 1.02 Mha of tree cover by taking an average of 1500 trees/hectare. The figure of 1500 trees per hectare conforms to actual survival rate of *Eucalyptus tereticornis* which was the most popular species planted by farmers under Farm Forestry in U.P. accounting for nearly 80% of the trees (Anon., 1992). The other preferred species included *Dalbergia sissoo* (3.1%), Poplar and fruit trees.

The other interesting features of the Farm Forestry programme was that nearly 61% of all trees planted were along farm bunds and boundaries, mostly single rows. Only 17% of trees were in the form of concentrated blocks, 8.6% were planted on cultivated fallow and 27.3% of trees were planted on farm lands. The total tree cover outside the forest areas added up to nearly 30% of the entire good natural forest cover of the State.

Profile of the farmers : Under the World Bank assisted Social Forestry Project of U.P., 70% plants purchased for tree farming under Farm Forestry was by medium and large farmers (representing 30% of the participants and 13% of Uttar Pradesh's total population). The remaining 30% plants were purchased by small farmers (representing 70% of the participants and 87% of the total population) (Anon., 1992). The large farmers are those with land holdings ranging from 1-10 hectares account for 30% of the total farmers in the State. However, Farmers with over 10 ha land holding account for only 0.5% of land holdings in the State (Anon., 1992).

Most planting has been done on marginal and sub-marginal land, on farm bunds, around the homesteads and along water channels. This type of forestry results in optimal use of available land resource without conflicting with other national priorities of growing food. Plantings for fuelwood production, while possibly of interest to the landless, has little appeal to landholders who generally meet their fuel needs from lops and other on-farm sources.

Table 1

Eucalyptus Overbark yields per cubic metre per hectare - Quality Class III

Year	1	2	3	4	5	6	7	8	9	10
Volume O.B. (m^3/ha)	0	0	6.2	12.9	21.5	28.8	34.4	38.3	42.4	45.9

Source : Chaturvedi, 1983.

Table 2

Total Carbon sequestered under Farm Forestry in UP during the period 1979-94

Year	Number of trees planted (in million)	Number of trees @ 80% survival (in million)	Trees converted to ha. @ 1500/ha	Volume of wood produced per ha/year (m^3)	Quantity of Carbon sequestered @ 0.5 tonnes per m^3 of wood (in tonnes)
1979-80	16.3	13.04	8693		
1980-81	66.7	53.36	35573	53899	26949
1981-82	146.8	117.44	78293	141904	70952
1982-83	254.0	203.20	135467	302064	151032
1983-84	252.3	201.84	134560	812859	406429.3
1984-85	355.0	284.00	189333	1701531	850765.3
1985-86	151.5	121.20	80800	2685872	1342936
1986-87	144.8	115.84	77227	4023888	2011944
1987-88	136.8	109.44	72960	4525920	2262960
1988-89	142.2	113.76	75840	4832432	2416216
1989-90	110.3	88.24	58827	4726923	2363461
1990-91	62.6	50.08	33387	4627520	2313760
1991-92	32.2	25.76	17173	4280773	2140387
1992-93	18.4	14.72	9813	3780784	1890392
1993-94	16.9	13.52	9013	3093413	1546707
Total	1906.8	1525.44	1016960	39589781	19794891

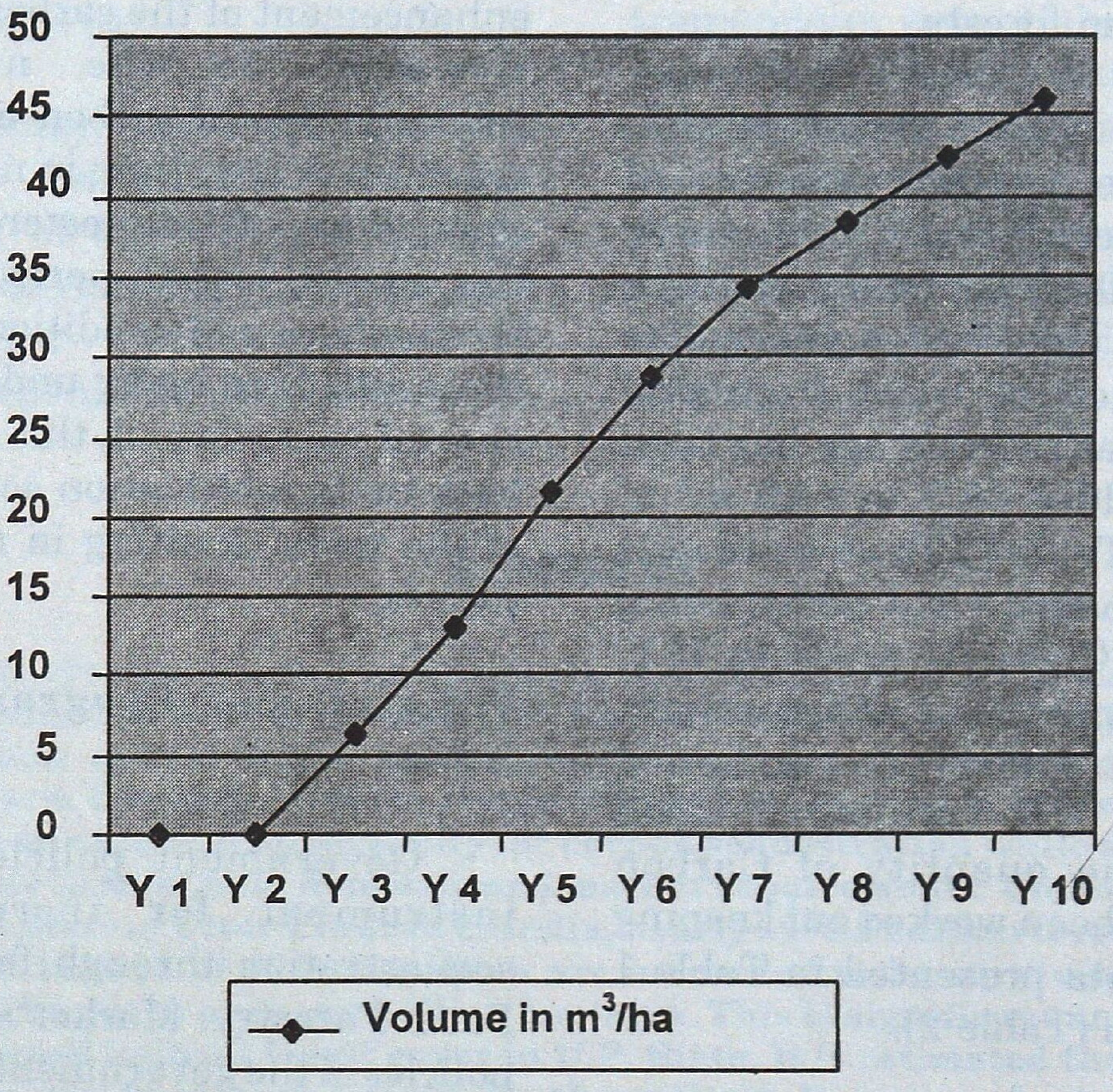
Source : U.P. Forest Department, 1994

Factors for Success : Experience with Farm Forestry in India has shown that the programme has flourished in areas where their exists a market for wood products. In U.P. State, major tree planting activity took place in regions which had within their catchments pulp and paper mills and peeling units for making plywood.

Carbon sequestration in Farm Forests

Farm Forestry plantations raised on farmers' fields are mainly on marginal and sub-marginal lands with low levels of soil Carbon. However, the soil Carbon in such areas rises quite rapidly and can reach levels of normal forests soils in a period of 15 to 25 years (Sampson and Sedja, 1997). Under the Farm Forestry regime in U.P., it is difficult to assess the soil Carbon owing to the short period of 8-10 years when these soils have tree growth. The carbon sequestered in this brief period is also minimal.

Fig. 1



Volume per hectare over different years of rotation for *Eucalyptus tereticornis*

Planted forests are known to taken up and store carbon at high rate compared to other world land covers. Storage rates commonly range from 1 to 8 mgC per ha per year (1 mg equals 10^6g), and typical mean Carbon storage over a rotation period is from 50 to 80 mgC per hectare (Winjum and Schroeder, 1995). Storage in products is transitory (these eventually decay) and much of the *in-situ* carbon stock may return to the atmosphere in Farm Forestry situations as planted lands are ultimately converted to non-forest use. However, Farm Forestry does lead to temporary lock in of atmospheric carbon.

Tree planting projects are often evaluated using mean storage over the life of the project. The same method has been followed in this study. In Farm Forestry, calculating carbon storage is relatively easy as more often than not, the choice of species by the farmer is dictated by market demand. In the case of U.P. Farm Forestry the market demand between the period 1979 to 1994 was for Eucalypts poles and pulp. Thus, calculations of Carbon sequestered during this period have been worked out keeping in view the growth pattern of *Eucalyptus tereticornis*.

When compared to forest protection projects, plantation projects especially with species commonly used by farmers in Farm Forestry, the amounts of biomass which would be produced over various periods of time is quite well known and can be quite accurately assessed. For the purposes of rough estimation of carbon, sequestered one can safely assume that the sequestration of nearly 0.5 tonnes of carbon

per cubic metre of harvestable wood produced from farm forests.

One hectare of farm forest in U.P. composed of the popular species of *Eucalyptus tereticornis* can have approximately 1500 trees at the end of a rotation period of eight to ten years. The average production of wood from this hectare would be at rotation age has been estimated to produce 38.3 to 45.9 m^3 of timber over bark (Table 1). These estimates are based on Standard yield tables being used for Quality Class III areas in U.P. State Forest Department (Chaturvedi, 1983). Based on the number of trees planted during 1979-94, the volume of wood produced and the quantity of Carbon sequestered have been worked out keeping the yield table data presented in Table 1 into consideration (Table 2).

From the above figures, it is clear that nearly 19.79 million tonnes of carbon is calculated to have been sequestered under Farm Forestry in U.P. The above figures only provide a broad picture of the role of Farm Forestry in carbon sequestration which itself is highly complex phenomenon. It is quite clearly understood that flows of carbon in old growth forests, which may hold large amounts of carbon within themselves, are often very small or none at all, since biomass additions is very little. In contrast, juvenile growth as seen in farm forests generates substantial flows by creation of large amounts of biomass.

An additional advantage of Farm Forestry projects is that despite a relatively small carbon lock in period of 8 to 10 years (which corresponds to the rotation of most farm forest species), most of the harvest is utilized for making wood based secondary products like pulp, plywood, packaging cases, furniture etc. These help in the enhancement of the carbon lock in period. However, on the negative side, sequestration of carbon as soil carbon is much lower here than in natural forests as the amounts of C sequestered in soils during the small C lock-in period is quite small. Even where soil conditions improve over time with land being under tree cover for several years on end, this land is often put back under cultivation soon after harvest of the trees resulting in rapid loss of soil carbon.

Policies and Programmes for the future

Government policies are a major instrument for increasing carbon sequestration through forestry including Farm Forestry. Market and environment policies of the government can boost or mar a Farm Forestry programme. For Farm Forestry to succeed in India, the formulation of a coordinated land-use strategy, agreed-upon land tenure rights that are unambiguous and not open to legal challenges, and markets developed enough to ensure a sustained demand for forest products, will be essential. Regulatory uncertainty can add to the risking of an investment in farm forestry. Tree Protection Acts in India which place restrictions on cutting of trees in non-forest areas are proving to be a major disincentive to farm forestry. An extension mechanism that addresses misplaced policy instruments requires to be put in place to make Farm Forestry more popular. All this will greatly assist in popularizing Farm Forestry with positive impacts on carbon sequestration, economic well-being, efficient and environmentally sound land-use practices, providing seasonal employment to the unemployed and the poorest of the poor,

encouraging growth of wood based cottage and other industry etc.

Farm Forestry, therefore, has the potential to contribute to the implementation of the Climate Change Policy. While developing policies and programmes for reducing load of atmospheric Carbon, due emphasis needs to be given to Farm Forestry whose tremendous potential needs to be fully exploited. Viable, multipurpose Farm Forestry based projects would need to be prepared for the purpose. Recognizing the potential of Farm Forestry, Governments must support its development through interventions at the policy and programme levels.

SUMMARY

Forests constitute both a sink and a source of atmospheric CO_2. In developing countries like India, the potential land area available for the implementation of forest management options for carbon conservation and sequestration is constrained by socio-economic circumstances. Farm Forestry involves the growth and management of trees on private lands and this provides an excellent opportunity for carbon sequestration while supplying wood and non-wood products to meet both domestic and market requirements. Under the Farm Forestry programme in the State of Uttar Pradesh in India, nearly 1906.8 million trees have been planted during the period 1979-94 of 1525.44 million are estimated to be surviving. In terms of land coverage, this works out to over one million hectares. This is significant and adds up to nearly 30% of the entire good natural forest cover in U.P. State. It is estimated that nearly 20 million tonnes of Carbon has been sequestered by these Farm Forestry plantations. Government policies and programmes that are supportive of Farm Forestry, could be the major instruments for increasing carbon sequestration from Farm Forestry, thus contributing to the implementation of the Climate Change Policy.

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टी०पी० सिंह, वी० वरलक्ष्मी व सुधीर के० आहलूवालिया

साराशं

वातावरण की कार्बन डायोक्साइड हेतु वन निमज्जन कुण्ड और स्रोत दोनों ही हैं । भारत जैसे विकासमान देशों में कार्बन संरक्षण और पृथक्करण हेतु वन प्रबन्ध विकल्पों को क्रियान्विति के लिए उपलब्ध भूमि क्षेत्र में समाजार्थिक परिस्थितियों के कारण कठिनाइयां होने से कृषि वानिकी में निजी भूमियों पर वृक्ष उगाना और उनका प्रबन्ध करना भी जरूरी होता है, तथा ऐसा होने से घरेलू और बाजारों दोनों की आवश्यकताएं काष्ठ और गैरकाष्ठ उत्पादों की पूरी करने के साथ-साथ कार्बन पृथक्करण का भी अत्युत्तम अवसर हमें मिल जाता है । भारत में इस उत्तर प्रदेश राज्य के कृषि वानिकी कार्यक्रमों के अन्तर्गत 1979-94 के दौरान लगभग 190.68 करोड़ वृक्ष लगाए गए जिनमें से अनुमान है, लगभग 152.54 करोड़ अभी भी उगे हुए होंगे । भूमि आवृत करके रखने की दृष्टि से इसका अर्थ दस लाख हेक्टेयर भूमि बनता है । यह काफी बड़ा क्षेत्र है और पूरे उत्तर प्रदेश राज्य के कुल वन क्षेत्र का लगभग 30% बैठता है । अनुमान है कि लगभग 2 करोड़ टन कार्बन इन कृषि वानिकी रोपवनों से पृथक्कृत हुई है । जो सरकारी नीतियां और कार्यक्रम कृषि वानिकी के सहायकारी हैं वे कृषि वानिकी द्वारा कार्बन पृथक्करण बढ़ाने के प्रधान उपकरण सिद्ध हो सकते हैं और इस तरह वे जलवायु परिष्कार नीति के क्रियान्वन में भी योग देते हैं ।

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MACRO-PROPAGATION OF SOME IMPORTANT MEDICINAL PLANTS OF ANDHRA PRADESH

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Introduction

In India, the use of different parts of several plants to cure specific ailments has been in vogue from ancient times. Many of the crude drugs which are source of medicinal preparations still come from the state of wild growth (Battacharjee, 1998). The natural resources howsoever large, are bound to diminish due to over-exploitation. There is an urgent need for conservation of all useful plant species and also cultivation, maintenance and assessment of germplasm for future use. Macro-propagation techniques of the following medicinal plants were studied in Regional Forest Research Centre, Rajahmundry, Andhra Pradesh as a part of germplasm conservation with different rooting hormones in detail. Their ethno-botany is taken from "Indian medicinal plants - a compendium of 500 species" (Anon., 1997).

(1) *Andrographis paniculata* (Burm.f.) Wall.ex Nees : The plant is a branched annual herb belonging to family Acanthaceae and is distributed throughout India, in the plains also in forests as under growth. The plant is bitter, acrid, cooling, laxative, vulnerary, anti-pyretic, anti-periodic, anti-inflammatory, expectorant, depurative, sudorific, anthelmenthic, digestive and stomachic. It is useful in malarial and intermittent fevers, sugar complaints besides other ailments.

(2) *Gymnema sylvestre* (Retz.) R.Br. : The plant is a large woody much branched climber with pubescent young parts belonging to the family Asclepiadaceae. The plant is bitter, astringent, acrid thermogenic, anti-inflammatory, anodyne, digestive, liver tonic, emetic, diuretic and stomachic. It is useful in inflammations, cough, asthma, bronchitis, intermittent fever etc. The fresh leaves when chewed have the remarkable property of paralysing the sense of taste for sweet and bitter substances for sometime.

(3) *Hemidesmus indicus* (Linn.) R.Br. : The plant is a perennial wiry shrub belonging to the family Asclepiadaceae. The root, leaves and stem are used in several medicinal preparations for curing leprosy, asthma, bronchitis, fever, leucoderma etc.

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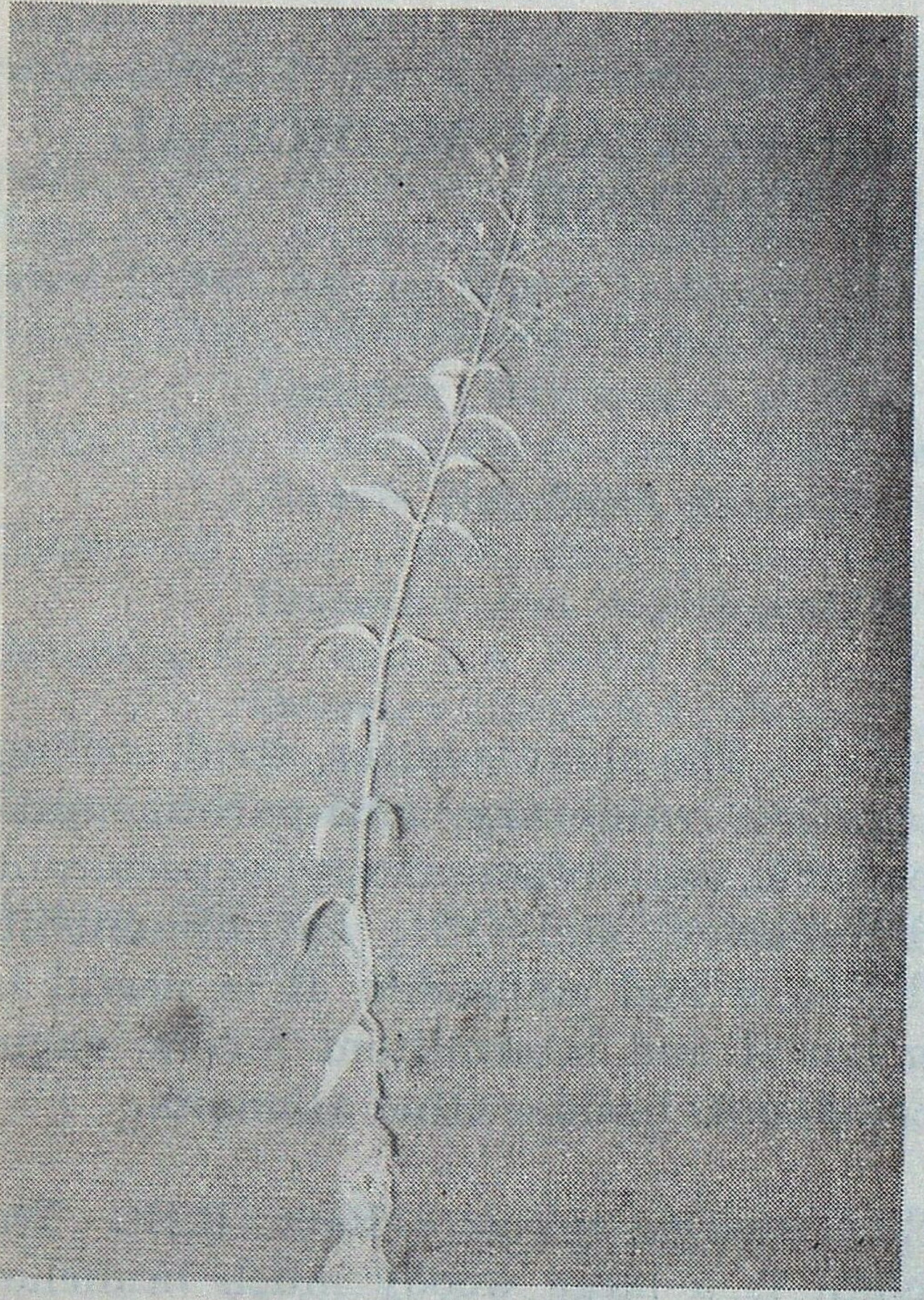
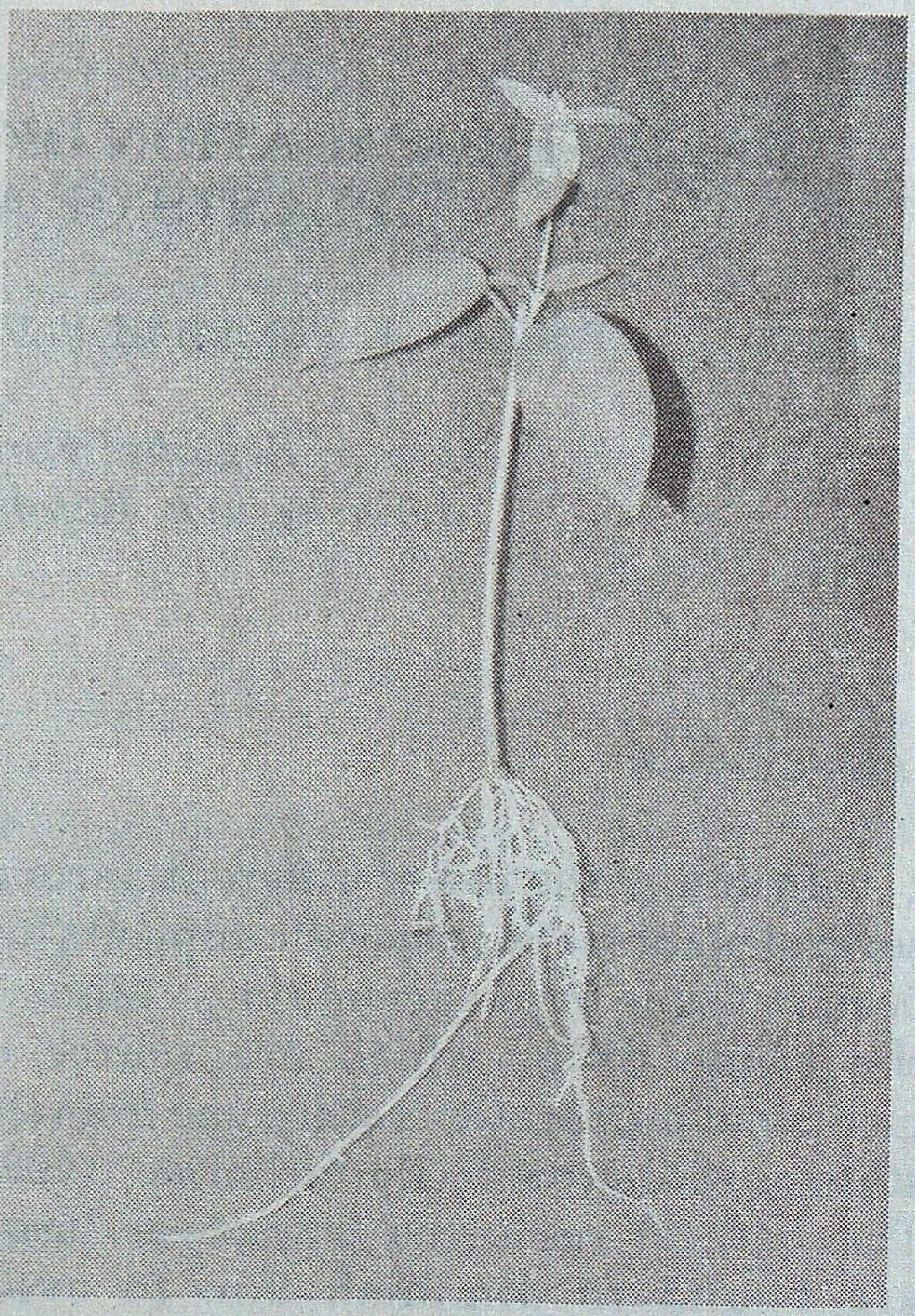
Fig. 1



Rooted cuttings of *Andrographis paniculata*

Fig. 2



Rooted cuttings of *Gymnema sylvestre*

(4) *Tinospora cordifolia* (Willd.) Miers ex Hook.f & Thoms. : A large extensively spreading glabrous, perennial deciduous twiner with cordate leaves belonging to the family Menispermaceae. The stem finds its use in chronic and intermittent fevers, skin diseases, leprosy, anemia, cough, asthma, jaundice, seminal weakness etc.

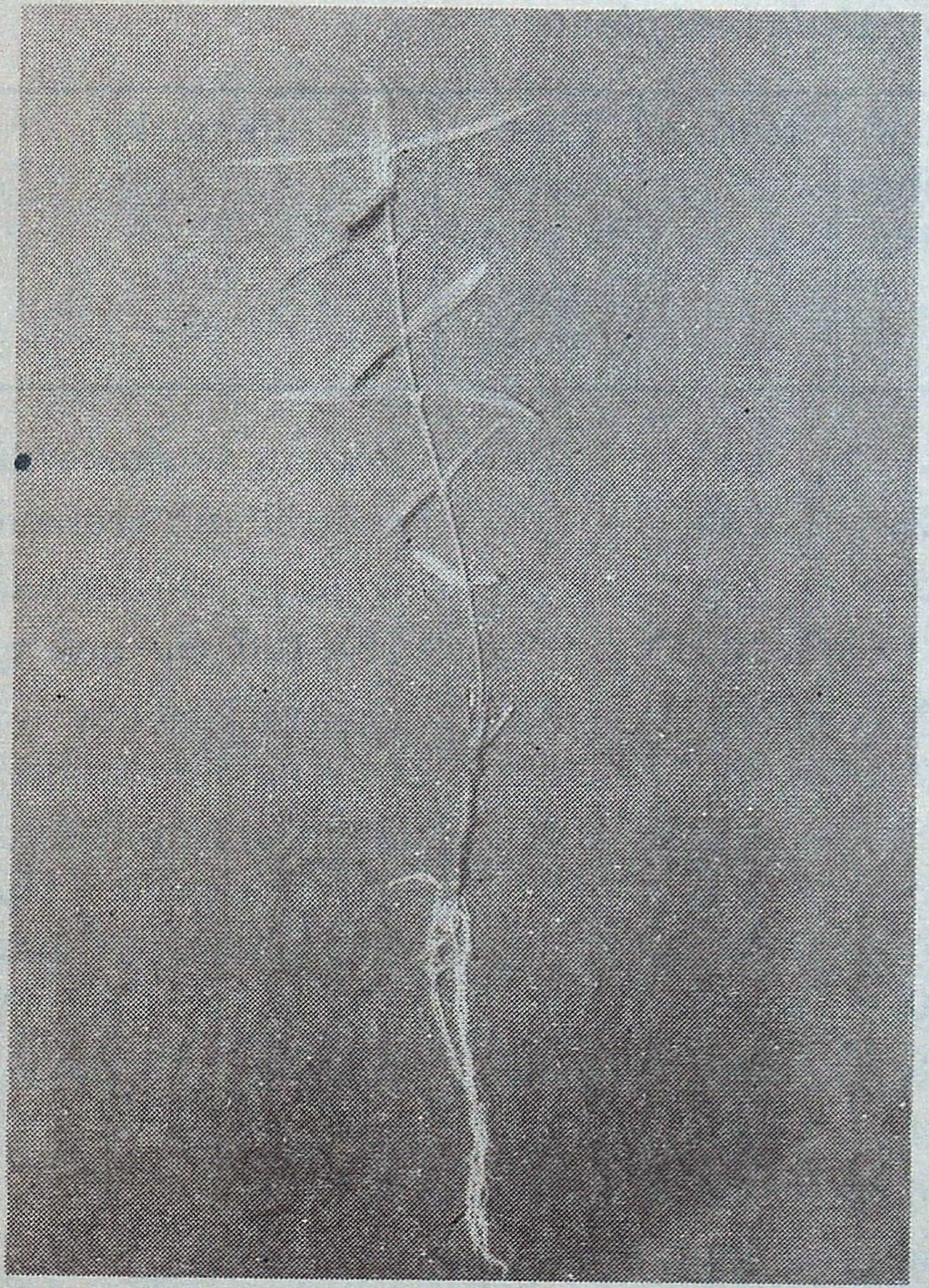
(5) *Tinospora tomentosa* Miers : It is also a perennial climber with oblong cordate leaves belonging to the family Menispermaceae. The aqueous extract of this plant is widely used in the traditional system of medicine for the treatment of jaundice, rheumatism, urinary diseases, intermittent fevers, eye and liver ailments.

These plants even though capable of producing enormous seeds, their availability is limited to a part of year. Hence, macro-propagation studies were conducted in Regional Forest Research Centre, Rajahmundry, Andhra Pradesh using different hormones.

Material and Methods

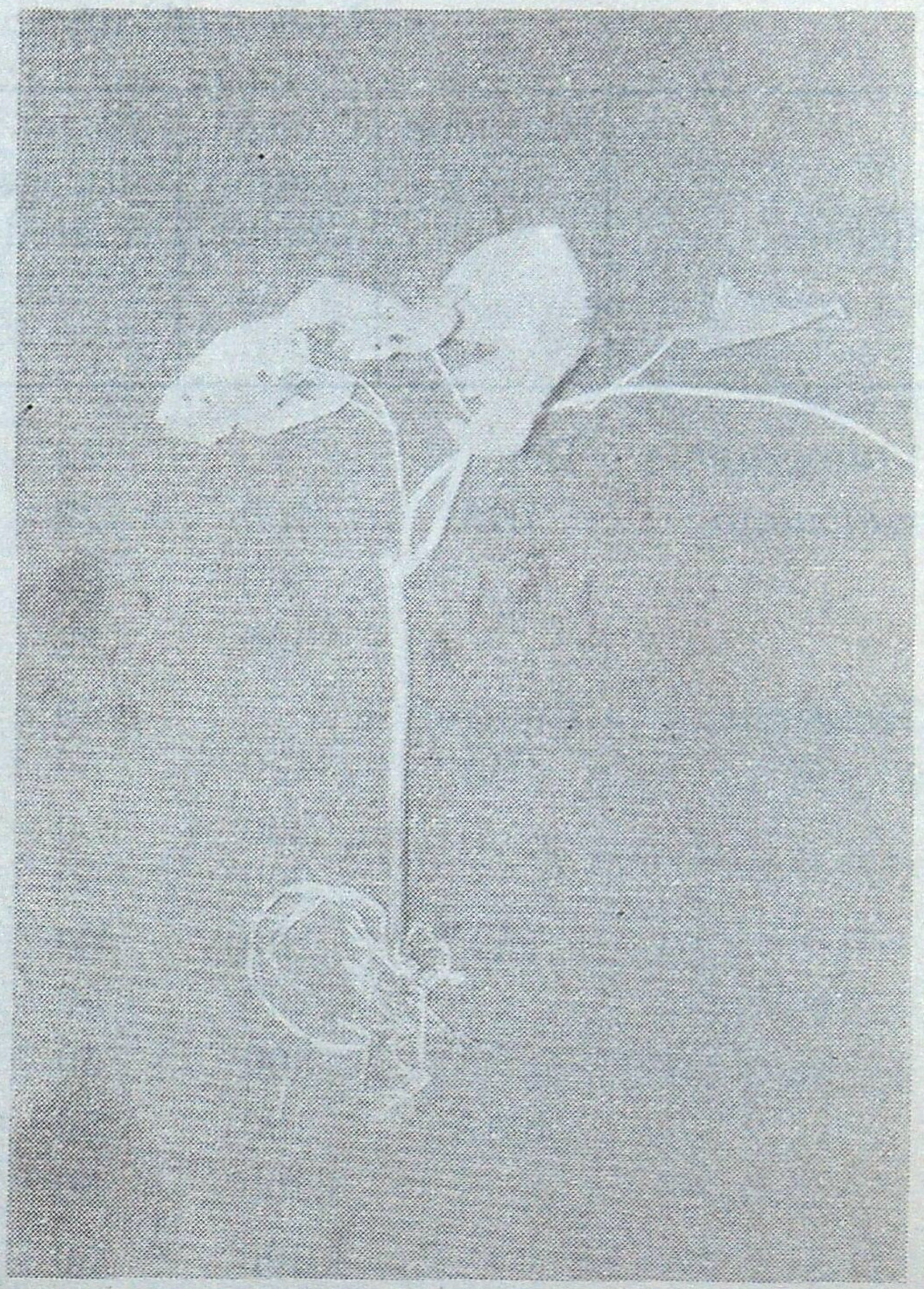
The rooting hormones IBA, IAA, NAA of required concentrations were prepared by dissolving 1g of powdered material in little quantity of propanol and making the final volume to 100ml with distilled water. From this 10,000 ppm stock solution, required concentrations were prepared by following serial dilution technique. The cuttings were brought from ethno-botanical garden existing in Regional Forest Research

Fig. 3



Rooted cuttings of *Hemidesmus indicus*

Fig. 4



Rooting cuttings of *Tinospora cordifolia*

Centre, Rajahmundry, Andhra Pradesh and studied the rooting process, by dipping the cuttings in different hormones of known concentration for 20 seconds (Quick dip method). The treated cuttings are kept in a mist chamber where temperature is maintained ± 5°C than the outside air temperature and relative humidity of 75-80%.

Results and Discussion

The data on rooting of leafy cuttings of medicinal plants is presented in Table 1. A perusal of the rooting of cuttings was indicated that these plants shall root even without any hormone treatment in mist chambers. In case of cuttings of *Andrographis paniculata*, 100% rooting was observed even without any hormonal treatment. While in *Gymnema sylvestre, Tinospora cordifolia, Tinospora tomentosa, Hemidesmus indicus* rooting was enhanced with hormonal treatment. Irrespective of type of hormone and concentrations used, in all these plants more than 70% rooting was observed. But, the rooting was slow and not profuse with control. In order to induce profuse rooting, there is necessity to treat the cuttings with hormones. Therefore, these medicinal plants can be successfully propagated by treating with growth regulators (either IBA or IAA or NAA) at lower concentrations (100 or 300 ppm) for large scale multiplication in lean periods of seed availability.

Table 1

Rooting of leafy cuttings of Medicinal plants

Species	Hormone used	Concentration (ppm)	No. of cuttings treated	No. of cuttings rooted	Rooting (%)	Time taken for rooting (days)	Remarks
Andrographis paniculata	Control	-	22	22	100	10	Rooting is slow with control and profuse & quick rooting with IBA 100 ppm noticed
	IBA	100	22	22	100	7	
		300	22	22	100	7	
		500	22	22	100	7	
Gymnema sylvestre	Control	-	50	35	70	45	Control has low rooting percentage. Rooting is quicker with increase of IBA concentrations. IBA 200 ppm induced 96% rooting in 21 days.
	IBA	100	50	42	84	30	
		200	50	48	96	21	
		300	50	48	96	27	
	IAA	100	50	40	80	30	
		200	50	40	80	30	
		300	50	48	96	30	
	NAA	100	50	44	88	30	
		200	50	46	92	30	
		300	50	44	88	30	
Hemidesmus indicus	Control	-	34	26	76.4	20	Control has slow & low rooting. Ideal concentration for rooting is IBA 200 ppm which has induced 100% rooting in 15 days.
	IBA	100	34	29	85.2	18	
		200	34	34	100	15	
		300	34	31	91.1	15	
	IAA	100	34	30	88.2	18	
		200	34	34	100	15	
		300	34	33	97.1	15	
	NAA	100	34	27	79.4	18	
		200	34	25	73.5	15	
		300	34	30	88.2	15	
Tinospora cordifolia	Control	-	15	13	86.6	30	With IBA treatment, rooting is enhanced than control. IBA 200 or IBA 300 ppm is most ideal for rooting.
	IBA	100	24	23	95.8	21	
		200	24	24	100	21	
		300	24	24	100	21	
		400	24	21	87.5	21	
Tinospora tomentosa	Control	-	15	11	73.3	25	IBA 300 ppm is most ideal for rooting.
	IBA	100	24	23	95.8	12	
		200	24	23	95.8	12	
		300	24	24	100	12	
		400	24	21	87.5	12	

SUMMARY

Macro-propagation of medicinal plants Viz., *Andrographis paniculata, Gymnema sylvestre, Hemidesmus indicus, Tinospora cordifolia* and *Tinospora tomentosa* were tried in Regional Forest Research Centre, Rajahmundry, Andhra Pradesh using root inducing hormones (IBA, NAA, IAA). The study indicated that these plants can be successfully propagated without any hormone (>70% rooting) but the rooting was slow and not profuse. The hormonal influence on rooting of these selected medicinal herbs along with concentration of hormone is presented.

आंध्र प्रदेश के कुछ महत्वपूर्ण औषध पादपों का वृहत् प्रवर्धन

पी०एस० राव, के० वेंकय्या, वी० मुरली व वी०वी०वी० सत्यनारायण

सारांश

कुछ औषध पादपों अर्थात् *एण्ड्रोग्राफिस पैनिकुलाटा, जिम्नेमा सिल्वेस्ट्रे, हेमिडेस्मस इण्डिकस, टाइनोस्पोरा कौर्डिफोलिया* और *टाइनोस्पोरा टोमेनटोसा* को वृहत प्रवर्धन परिमाण पर क्षेत्रीय वन अनुसन्धान केन्द्र, राजमहेन्द्री, आंध प्रदेश में जड़े निकलना प्रेरक हार्मोन (इण्डोल ब्यूटिरिक अम्ल, न्यूक्लिइक एसेटिक अम्ल और इण्डोल एसेटिक अम्ल) उपयोग में लाकर प्रवर्धित करने का प्रयास किया गया । इस अध्ययन ने सूचित किया कि ये पादप बिना किसी हार्मोन के भी सफलतापूर्वक प्रवर्धित किए जा सकते हैं (जड़ें निकलना > 70%) परन्तु जड़ें निकलने की गति मन्द रहती है तथा वे प्रचुरता से नहीं निकलती । इन चुने हुए औषध पादपों में जड़ें निकलने पर पड़े प्रभावों और उनमें प्रयुक्त हार्मोनों के संकेन्द्रणों को यहां प्रस्तुत किया गया है ।

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FACTOR ANALYSIS OF SOIL NUTRIENT DISTRIBUTION PATTERN UNDER DIFFERENT PLANTATIONS

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Introduction

The common problem for foresters regarding social forestry plantations is to make strategies for improvement of the soil conditions and to raise the biomass production. Different cover types affect downward movement of water in the soil in different ways (Megahan *et al.*, 1962; Nazaror, 1969), hence different plantations may have their different effects on soil nutrients. The heterogeneous distribution in soil properties has been attributed to greater erosion of soil nutrients from different canopies and the uptake and sequestration of nutrients in accumulated litter and soil organic matter under different canopies. However, litter accumulation, nutrient sequestration, and the vulnerability of a soil to erosion vary with soil texture and parent material (Woolridge, 1964; Willen, 1965) confounding the independent effects of soil and vegetation on individual soil properties. In addition, many soil properties of change resulting from different management practices or biotic and abiotic influences on soil properties (Holland, 1969; Norris, 1970).

Multivariate statistical analysis provides techniques for studying the joint relationship of variables that are correlated. Because several variables are considered simultaneously, interpretations can be made that are not possible with univariate analysis and stronger conclusions can be made than attainable from analysis of single variable comparisons (James and McCulloch, 1990).

In contrasts, the objective of factor analysis is to identify underlying factors that are responsible for the correlation among the variables (Johnson and Wichern, 1992; Sharma, 1996). Using factor analysis, the correlation matrix from a large number of correlated variable can be decomposed into the variance attributed to the underlying factors and the variance unique to each variable (Sharma, 1996). Factor analysis can reveal relationships not previously suspected, and allow interpretations that would not ordinarily result from univariate analysis (Johnson and Wichern, 1992).

The objectives of this study were to

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identify underlying factor patterns on soil chemical properties from five plantations using factor analysis, and analyses of factor scores to determine how the factor patterns vary between two seasons, five canopies and six soil depths.

Material and Methods

Study area : Five plantations i.e. *Dalbergia sissoo* (Shisham), *Pinus roxburghii* (Chir), *Eucalyptus* (Safeda), *Tectona grandis* (Teak, *Acacia catechu* (Khair) were selected in Domet block of Langha Forest range of Mussoorie Forest Division of Uttar Pradesh, India. The site had similar slope, aspect, soil geology, altitude, biotic interference etc. so that these factors could not have any influence on the results. Changes in the soil nutrient status due to the seasonal variation under all block plantations were determined twice a year i.e. pre-monsoon (spring season in the month of March) and post-monsoon (autumn season in the month of October). Climatically, it was a tropical site, having mean annual rainfall of about 1600 mm. Maximum temperature vary from 22°C to 38°C while minimum temperature vary from 4°C to 25°C.

Soil of Study area : Soil was silty loam in texture under Chir and Shisham while loamy sand under Teak and sandy loam under *Eucalyptus* throughout the soil profile. Under Khair, top layer was loam and middle layer was clay loam. Soil under all plantations were acidic in reaction and well supplied with nitrogen, phosphorus, potassium and calcium.

Data Collection : Soil samples were collected from three randomly selected sampling points under each plantations. Soil samples were collected from different depths viz., 0-10, 10-30, 30-60, 60-90, 90-120 and 120-150 cm. Soil samples were analysed for Organic Carbon by Walkley-Black procedure. Soil chemical analysis used was done as described by Piper (1966). The descriptive statistics of chemical properties for the five plantations are given in Table 1.

Factor Analysis : Factor analysis was performed using SPSS (Anon., 1997). Due to different measurements units of soil variables, the analysis has been performed on the correlation matrix after transforming the soil variables which were recorded in percentage (Howard, 1992) rather than the variance - covariance matrix to eliminate the effects of different measurements units in the determination of factor loading (James and McCulloch, 1990; Johnson and Wichern, 1992). Principal component analysis was used as the method of factor extraction, and all factors with eigen values >0.80 were subjected to on orthogonal rotation using varimax rotation method with Kaiser Normalization (Anon., 1997). A varimax rotation redistributes the variance of each variable so that each variable loads highly on only one factor with near-zero loadings on other factors (Sharma, 1996) and it also minimize the number of variables that have high loading on each factor. Soil variables used were total nitrogen, phosphorus, potassium, calcium and sodium, available nitrogen, phosphorus, potassium and organic carbon.

Two of the most common multivariate analyses used with data are principal-component analysis and factor analysis. However, the objective of these two analyses differs. Principal-components analysis is a data reduction technique that places emphasis on explaining the variance on the data while reducing the number of variables to a few components. Each component forms

Table 1

Mean and standard deviations (S.D.) of soil chemical properties at six depths under different plantations (pooled across all six depths)

Seasons		O.M. (%)	Total N (%)	Avail. N (%)	Total K (%)	Avail. K (%)	Total P (%)	Avail. P (%)	Total Ca (%)	Total Na (%)
Pinus roxburghii Plantation										
Before	Mean	0.74	0.0291	0.0028	0.6064	0.0049	0.0332	0.0016	0.4030	0.4510
Monsoon	S.D.	0.43	0.0153	0.0016	0.1784	0.0015	0.0095	0.0008	0.0697	0.0930
After	Mean	1.35	0.0524	0.0046	0.3613	0.0052	0.0296	0.0020	0.4208	0.0232
Monsoon	S.D.	0.49	0.0195	0.0019	0.1728	0.0020	0.0089	0.0007	0.0707	0.1205
Tectona grandis Plantation										
Before	Mean	0.96	0.0398	0.0034	0.5985	0.0038	0.0263	0.0032	0.4164	0.3712
Monsoon	S.D.	0.48	0.0160	0.0015	0.1982	0.0012	0.0056	0.0016	0.0702	0.0107
After	Mean	0.51	0.0368	0.0029	0.7053	0.0061	0.0254	0.0015	0.3689	0.2600
Monsoon	S.D.	0.42	0.0156	0.0014	0.3536	0.0029	0.0064	0.0003	0.0496	0.1009
Eucalyptus Plantation										
Before	Mean	1.23	0.1144	0.0058	0.6438	0.0048	0.0199	0.0039	0.4566	0.3121
Monsoon	S.D.	0.61	0.2073	0.0020	0.1569	0.0025	0.0101	0.0015	0.0421	0.0569
After	Mean	1.89	0.0778	0.0069	0.6042	0.0056	0.0220	0.0020	0.4518	0.1606
Monsoon	S.D.	0.58	0.0283	0.0026	0.1305	0.0031	0.0066	0.0010	0.0936	0.0834
Dalbergia sissoo Plantation										
Before	Mean	1.41	0.0653	0.0058	0.7516	0.0067	0.0306	0.0030	0.5294	0.4243
Monsoon	S.D.	0.54	0.0218	0.0018	0.1381	0.0024	0.0120	0.0009	0.0991	0.0967
After	Mean	1.85	0.0701	0.0062	0.8372	0.0063	0.0322	0.0026	0.5225	0.2667
Monsoon	S.D.	0.60	0.0263	0.0025	0.1716	0.0023	0.0106	0.0007	0.1207	0.0598
Acacia catechu Plantation										
Before	Mean	0.86	0.0611	0.0053	0.8068	0.0071	0.0210	0.0018	0.5426	0.5221
Monsoon	S.D.	0.80	0.0291	0.0027	0.3044	0.0034	0.0186	0.0007	0.0622	0.0863
After	Mean	1.34	0.0592	0.0050	0.9126	0.0105	0.0177	0.0019	0.4670	0.2628
Monsoon	S.D.	0.74	0.0290	0.0025	0.3127	0.0029	0.0039	0.0003	0.0758	0.0771

a new variables and the number of retained components explains the maximum amount of variance in the data (Sharma, 1996).

Univariate Analysis : Factor scores are linear transformations of the original variables and estimates of values for the unobserved factors (Johnson and Wichern, 1992). Rotated factor scores from each observation were computed using SPSS

and analysed by analysis of variance using a factorial randomised block design treating plantations, depth, and season, as fixed factors. The coefficients of factor scores were worked out by Anderson-Rubin method, which ensures orthogonality of the estimated factor. The scores produced through this method have mean 0 and standard deviation 1 and are uncorrelated.

Results and Discussion

Soil parameters are correlated in all five plantations. In general, available nitrogen and total calcium is having high positive correlation with all soil parameters. It may be because of organic carbon, total and available phosphorus are intimately linked with soil humus. Positive relationship with total and available potassium were obtained mainly because of soil humus acting as nutrient reservoir. Whereas available phosphorus is having positive correlation with exchangeable and available nitrogen and total calcium and phosphorus.

The Kaiser - Meyer - Olkin Measure of sampling adequacy, which tests whether the partial correlation among the variables are small, was 0.678 and Bartlett's test of sphericity, which tests whether the correlation matrix is an identity matrix was significant that is the factor model is appropriate.

Eigen values for the first four factors were >0.90 and combined accounted for 77 per cent of the total variation in the soil variables (Table 2).

Communalities estimated the portion of variance in each variable that was explained by the factor model. The four factor model explained > 90 per cent of the variance in total phosphorus; 85 per cent of the variance in organic matter and available nitrogen and >70 per cent of the variance in total nitrogen, total potassium, and total sodium, available potassium and available phosphorus. Furthermore, the four factor model explained only 62 per cent of the

Table 2

Rotated factor loadings and communalities of a four factor model of chemical properties of soils at six depths under different plantations

Soil Variables	Factor Loadings				Communalities
	1	2	3	4	
Organic Matter	0.874	-0.109	0.212	0.187	0.855
Total Nitrogen	0.791	0.020	0.300	-0.073	0.722
Total Phosphorus	-0.056	0.070	-0.056	0.957	0.927
Total Potassium	0.677	0.417	-0.253	-0.136	0.714
Total Calcium	0.160	0.708	0.253	0.178	0.622
Total Sodium	-0.087	0.869	-0.118	-0.058	0.780
Av. Nitrogen	0.926	0.040	0.174	0.002	0.888
Av. Phosphorus	0.133	0.050	0.847	-0.058	0.741
Av. Potassium	0.730	0.060	-0.337	-0.244	0.710
Per cent of Variance	36.58	16.16	12.67	11.92	

Table 3

Analysis of variance and mean squares for the different source of variance

Source	df	Mean Square			
		Factor 1	Factor 2	Factor 3	Factor 4
Replication	2	0.730*	2.281**	0.108	3.973**
Season	1	8.972**	51.063**	8.914**	1.724
Species	4	9.816**	10.553**	12.149**	11.871**
Depth	5	20.113**	0.535	0.706	0.423
Season x Species	4	0.477**	1.395**	10.267	1.336
Season x Depths	5	0.097	0.789	0.348	1.139
Species x Depths	20	0.117	0.433	0.460	1.080**
Season x Sp. x Dep.	20	0.070	0.393	0.780	0.651
Error	118	0.181	0.441	0.425	0.651

*Significant at 5 per cent level of significance.
**Significant at 1 per cent level of significance.

variance in total calcium. Less importance should be ascribed to variables with low communalities than to those with high communalities when interpreting the variable associations represented by a factor. Factor loading are the simple correlation between the original soil variation and the factors. The first factor accounted for 36.6 per cent of the total variation in the soil variables, and had high positive factor loading on available nitrogen and organic matter (Table 2). The first factor was termed as the aggrading factor because the two soil variables with high loading in this factor represent the aggrading effect resulting from the accumulation of litter and soil organic matter on soil properties.

Aggrading factor scores varied significantly between seasons and species resulting in a significant season x species interactions (Table 3). For aggrading factor, the factor scores was maximum (positive) for Shisham, which is statistically at par with *Eucalyptus* and Khair and minimum (negative values) for Teak, which is statistically at par with Chir (Table 4a). Higher organic matter and available N under Shisham and *Eucalyptus* are due to higher accumulation of litter at surface under these plantations.

Whereas the factor scores for depths were reflecting a decreasing trends for aggragading factor. The maximum were for 0-10 cm and minimum scores were for 120-150 cm, which is statistically at par with 90-120 cm (Table 4b). That is, as depth is increasing the effect of organic matter and total nitrogen is decreasing. It may be because of lesser root activities and restricted leaching down the soil profile. The rate of decomposition determines the humification activities and migration of soluble material to lower depths. Accumulation of humus is sizeable at top layer and humus found in lower layers consists of the leached fraction and decayed products of under ground root biomass

Table 4a

Homogeneous groups for the plantations

Canopies	Factor 1	Factor 2	Factor 3	Factor 4
Tectona grandis	-0.6348a	-0.2215a	-0.2005a	-0.1144b
Pinus roxburghii	-0.4901a	-0.4221a	-0.3546a	0.5645c
Acacia catechu	0.2803b	0.6668b	-0.6238a	-0.7883a
Eucalyptus	0.3442b	-0.5119a	0.8129b	-0.2238ab
Dalbergia sissoo	0.5004b	0.4885b	0.3660b	0.5619c

Table 4b

Homogeneous groups for the depths

Depths (cm)	Factor 1	Factor 2	Factor 3	Factor 4
0-10	1.2133a	0.1710	-0.1676	-0.1067
10-30	0.6337b	-0.0600	-0.1000	-0.1515
30-60	0.1054c	-0.1344	0.0220	-0.0500
60-90	-0.3269d	-0.1452	0.0380	0.1106
90-120	-0.6721de	0.0570	0.0048	0.0640
120-150	-0.9534e	0.1154	0.2786	0.1326

Alphabets representing statistical homogeneous groups

Kaiser-Meyr-Olkin measure of sampling adequacy = 0.678
Bartlett's Test of sphericity = 704.367**

supporting the decreasing trend. However there were no significant difference for interaction between season and depth and species and depth. This indicates that the aggrading effects resulting from accumulated litter and organic matter under different canopies and in different seasons were consistent. Organic matter and nitrogen are the main factors responsible for soil fertility and to ascertain the soil condition. Therefore, this factor is explaining maximum (36.6 per cent) variation in the soil variable.

The second factor accounted 16.16 per cent of the total variation in the soil variables and had high positive factor loading on total sodium (Table 2). The second factors was termed as sodium factor. Sodium factor scores varied significantly between two seasons, species and interaction between season and species (Table 3). The sodium factor scores were negative for the soils under the canopies of Chir, Teak and *Eucalyptus* because of relatively low sodium and moderate organic matter value and positive for Khair and

Shisham, due to higher organic matter and high total sodium (Table 1). The two seasons after monsoon and before monsoon were statistically significant and five species were making two separate group (Table 4a). The maximum score were for Khair which were statistically at par with Shisham whereas minimum for *Eucalyptus*, which were statistically at par with Teak and Chir. The soils under Khair and Shisham showed higher cations (total calcium, potassium, and sodium) contents as compared to Chir, Teak and *Eucalyptus*. The likelihood of higher nutrient store in soils with higher organic matter content is an established fact because of more exchangeable site available to hold nutrient against leaching losses. Clay and humus create exchangeable capacity in the soil. The exchangeable capacity under Khair and Shisham is more because of higher clay and humus content compared to Teak, Chir and *Eucalyptus*. Soil depths were non-significant (Table 4).

The third factor accounted for 12.7 per cent of the total variation in the soil variables and had high positive loading for available phosphorus. Thus this factor can be named as phosphorus factor. This factor is having negative values for Teak, Chir and Khair due to low value of available phosphorus and available potassium and having positive values for *Eucalyptus* and Shisham due to high value of available phosphorus and of available potassium (Table 1). Under *Eucalyptus* and Shisham, organic matter content were higher. Phosphorus has intimate linked with soil organic matter. Phosphorus level in soil are govern by the nature of soil humus, content of annual addition on forest floor, hence phosphorus content were higher in these plantations. Tree derive their phosphorus chiefly from calcium phosphate and organic phosphorus compounds. Under *Eucalyptus* and Shisham, calcium content were higher which facilitate the growth of these plantations. Available potassium content in soil supported by *Eucalyptus* and Shisham were higher because of higher organic matter and due to overriding influence of soil organic matter through which much of the soil potassium is cycled and also because of its acting as nutrient reservoir.

For phosphorus factor, seasons were significant, reflecting that there is difference in available phosphorus during two seasons. Seasonal changes in phosphorus is influenced by weather factors like rainfall, temperature etc. because these factors govern the microbial activities in the soil. Therefore, significant differences among season were achieved. Significant differences were observed among species. Two homogeneous groups for species were resulted by application of Schelte test after analysing of factor score. The maximum score were observed for *Eucalyptus*, which were statistically at par with Shisham and minimum were for Khair, which is statistically at par with Chir and Teak. Significant differences in phosphorus content among species, observed in this study may be because of the release of nutrients in different proportion from the litter of different plantations, after decomposition. Phosphorus content and its distribution pattern shall strongly depend upon the biochemical activities in the soil as well as on its own chemical behaviour in the given conditions.

The fourth factor accounted 11.9 per cent of the total variation in the soil variables and had high positive loading on total phosphorus and low negative loading on available potassium. The fourth factor were formed as total phosphorus factor.

This factor scores varied significantly for interaction between seasons and depths. The species were having three homogeneous groups (Table 4a). The maximum scores were for Chir which were statistically at par with Shisham, whereas the minimum scores were observed for Khair, which were statistically at par with *Eucalyptus*. It is interesting to note that for phosphorus factor based on available phosphorus soils under *Eucalyptus* have higher score while for total factor same soil have low score. It may be because of the relationship between total and available phosphorus has not been uniform. The conversion of total phosphorus to available phosphorus is mostly influenced by several factors of chemical and biological in nature. Therefore, this trend was observed. The significance of these factor reflects that the total phosphorus were varied markedly with canopy cover and did not vary with depths as also reflected by Table 1. Due to the immobility of phosphorus in soil, the uneven distribution of phosphorus in soil may obtained. In many cases phosphorus level in soil remain independent of soil depths as well as total and available forms were also mutually independent of each other.

Silvicultural management should be focused to retain higher humus in soil making full use of soils containing higher amount of clay. This would also encourage more hydrated conditions in rhizosphere for better growth performance by the trees.

SUMMARY

Factor analysis of soil nutrient distribution pattern under Chir, Teak, *Eucalyptus*, Shisham and Khair, in Mussoorie Forest Division (U.P.) was studied. It was done to identify underlying factors that are responsible for correlation among nutrients under five plantations. Eigen values for the first four factors were >0.90 and combined accounted for 77 per cent of total variation in the soil supporting the five plantations. The four factor model explained > 90 per cent of the variance in total phosphorus; 85 per cent of the variance in organic matter and available nitrogen; and > 70 per cent of the variance in total nitrogen, total potassium, and total sodium, available potassium and available phosphorus. However the four factor model explained only 62 per cent of the variance in available potassium and 66 per cent of the variance in total calcium. The four extracted factors are aggrading factor (36.6 per cent), Sodium factor (16.16 per cent), Phosphorus factor (12.67 per cent) and total phosphorus factor (11.92 per cent) obtain through varimax orthogonal factor analysis.

विभिन्न रोपवनों में मृदा पोष्याहारों की वितरण सज्जा में कारकों का विश्लेषण

एम०एन० झा, एम०के० गुप्त व राजीव पाण्डेय

सारांश

मसूरी वन मण्डल (उ०प्र०) में चीड़, सागौन, युकेलिप्टस, शीशम और खैर रोपवनों में मृदा पोष्याहारों की वितरण सज्जा में कारकों के विश्लेषण का अध्ययन किया गया । यह अध्ययन उन कारकों का पता लगाने के लिए किया गया जो दन पांच रोपवनों में पोष्याहारों के विभिन्न सहसम्बन्धों के लिए उत्तरदायी होते हैं । प्रथम चार कारकों की आइगेन अर्हाएं > 0.90 थी और मिलकर वही पांचों रोपवनों को धारण करती मृदा की कुल विभिन्नता के 77% भाग के लिए उत्तरदायी थे । चार कारकों के इस मॉडल ने कुल फास्फोरस की >90% विभिन्नता जैव पदार्थों ओर उपलब्ध नाइट्रोजन की 85% विभिन्नता तथा कुल नाइट्रोजन, कुल पोटाशियम तथा कुल सोडियम, उपलब्ध पोटाशियम और उपलब्ध फास्फोरस की >70% विभिन्नता का स्पष्टीकरण किया । तथापि, इन चार कारक मॉडल से उपलब्ध पोटाशियम की 62% विभिन्नता

और कुल कैलशियम की 66% विभिन्नता का ही स्पष्टीकरण मिल पाया । ये चार निष्कर्षित कारक ही श्रेणीकारक हैं (36.6%), सोडियम कारक (16.6%), फास्फोरस कारक (12.67%) और कुल फास्फोरस कारक (11.92%) जो वैरिमैक्स ऋजुरेखीय कारक विश्लेषण से प्राप्त किए गए ।

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FOLIAR NUTRIENTS OF SIX FOREST TREE SPECIES GROWN IN BROWN HILL SOILS OF BANGLADESH

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Introduction

The Southern and Eastern hilly areas cover almost 12% land area of Bangladesh. These hilly areas were once covered with dense tropical rainforest which has largely been deforested due to shifting cultivation and forest encroachment. Some hills have been reforested by slash and burn procedure with exotic Teak and presently some fast growing exotic trees such as *Acacia auriculiformis*, *Acacia mangium*, *Eucalyptus camaldulensis*, *Hevea brasiliensis*, *Pinus caribaea* etc. are being planted. Plantations of some indigenous species such as *Dipterocarpus* spp. *Lagerstroemia* spp., *Sygygium grande*, etc. have also been raised. There is, however, little information regarding the nutrient requirement of these different species. The soils there have been classified under the same general soil type - Brown Hill Soil (Shaheed, 1984). There is also much less information regarding the fertility levels of these soils. Since the plantations are not fertilized, there remains the possibility of fertility exhaustion by some high nutrient demanding species. There is even a chance of planting a species at an unsuitable site. This emphasizes the need for evaluating both the nutrient demand of different tree species and nutrient reserves of the soil. The present study is an attempt in this regard.

Material and Methods

Sampling : Fully grown mature leaves of six forest tree species e.g. *Acacia auriculiformis* A. Cunn. Ex Benth., *Acacia mangium* Willd., *Eucalyptus camaldulensis* Dehnh. and *Pinus caribaea* Morelet. var. *hondurensis* Barr and Golf, aged between 4 and 10 years, were collected from plantations in Chittagong, Chittagong Hill Tracts and Cox's Bazar Forest Divisions. Leaves from *Dipterocarpus turbinatus*, Gaertn.f. and *Dipterocarpus costatus* Gaertn. f. plantations were obtained from Dulahazara and Harbang of Cox's Bazar Forest Division and Keochia of Bandarban Forest Division. Leaves of natural *D. turbinatus* and *D. costatus* were taken from different localities of the same area Dulahazara. Leaves/needles from mid-canopy leaves were collected in November, 1994 from 10 random trees of each plantation/natural site. Samples of each plantation/natural site were lumped together and processed for analysis. There

were 7, 10, 7, 6, 4 and 4 plantations of *A. auriculiformis*, *A. mangium*, *E. camaldulensis*, *P. caribaea*, *D. costatus* and *D. turbinatus* respectively. There were 10 sites where *D. costatus* and *D. turbinatus* occurred mixed naturally.

Soil samples were collected at 15 cm intervals upto 75 cm depth under each tree from which leaves/needles were collected. Soil samples for each depth and each plantation/site were mixed in equal proportion to form a composite sample. These soils were sandy loam to clay loam in texture, well drained and moderately to extremely acid (pH 4.2 to 5.8).

Analysis : Leaf/needle samples were dried in an oven at 65°C for 24 hours. These were ground to pass through 0.1 mm mesh. 0.1 g oven dry leaf/needle powder was digested in conc. H_2SO_4 + H_2O_2 + Lithium sulfate + Se mixture (Allen *et al.*, 1986). Nitrogen was determined by Microkjeldahl distillation, P by vanadomolybdate yellow colour spectrophotometric method and K, Ca, Mg, Fe, Mn and Zn by atomic absorption spectrophotometer. The average concentration of each nutrient for each species was calculated.

Available phosphorus was extracted from field moist soil with 0.03 N NH_4F in 0.1N HCl, available K, Ca, Mg, Mn and Zn with 1 N NH_4 OAc (pH 7.0) and available Fe with 1 N NH_4OAc (pH 4.6). P was determined spectrophotometrically according to the $SnCl_2$ reduced molybdophosphoric blue colour method. Determinations of other elements were done similarly as for leaf analysis. Total nitrogen was determined according to Microkjeldahl digestion followed by Microkjeldahl distillation (Dewis and Freitas, 1970).

Results and Discussion

Foliar Nutrients : Table 1 shows the average foliar nutrient concentrations of the different species. Nitrogen concentration was the highest in the two leguminous tree species *A. auriculiformis* and *A. mangium* which did not differ significantly from each other (2.43 and 2.39% respectively). Needles of *P. caribaea* contained the least N (0.73%) which was significantly different from *E. camaldulensis* (0.95%). The two *Dipterocarpus* species, planted or natural, did not differ in foliar N concentration (1.40 to 1.52%). All these six species contained statistically similar concentration of P (0.19 to 0.23%) although *P. caribaea* had the least value. The K concentrations in *Dipterocarpus* species were also similar (except *D. turbinatus* plantation being slightly higher) but significantly different from other species. *P. caribaea* had only 0.36% K in needle while *A. auriculiformis* had the highest concentration of 1.18%. *A. mangium* differed significantly from *A. auriculiformis* but not from *E. camaldulensis* in foliar K. Foliar Ca concentration was similar in *D. turbinatus*, *D. costatus* and *P. caribaea* (0.93 to 1.02%) but differed significantly from other species. Calcium concentration was the highest in *E. camaldulensis* (1.72%) followed by *A. auriculiformis* (1.52%) and *A. mangium* (1.23%). Thus, the two *Acacias* had significant difference in foliar Ca concentration. Foliar Mg concentration was also the highest in *E. camaldulensis* (0.50%). Natural *D. turbinatus* had significantly higher values than the other Dipterocarps. *D. costatus* (natural/planted) and *D. turbinatus* plantation had the least Mg concentration. There was no significant difference between. *A. auriculiformis* and *P. caribaea* in this regard. Iron concentration in these species except

Table 1

Average foliar nutrient concentration in different tree species grown in Brown Hill Soils of Bangladesh

Species	N	P	K	Ca	Mg	Fe	Mn	Zn
	(%)					ppm		
A. auriculiformis (7)*	2.43 ± 0.06a**	0.23 ± 0.002a	1.18 ± 0.02a	1.52 ± 0.08a	0.44 ± 0.04a	203 ± 23a	207 ± 32a	82 ± 10a
A. mangium (10)	2.39 ± 0.12a	0.23 ± 0.003a	0.93 ± 0.08 b	1.23 ± 0.04 b	0.36 ± 0.02 b	217 ± 11 a	400 ± 32 b	80 ± 7a
E. camaldulensis (7)	0.95 ± 0.08c	0.22 ± 0.006a	1.89 ± 0.10c	1.72 ± 0.15c	0.50 ± 0.02c	177 ± 9b	1906 ± 434c	92 ± 13a
P. caribaec (6)	0.73 ± 0.03d	0.19 ± 0.004a	0.36 ± 0.05d	1.02 ± 0.14d	0.41 ± 0.02a	215 ± 14a	1111 ± 183d	59 ± 7 b
D. costatus (10) (Natural)	1.45 ± 0.05b	0.23 ± 0.003a	0.57 ± 0.03e	1.02 ± 0.02d	0.31 ± 0.01d	224 ± 10a	497 ± 46b	100 ± 6c
D. costatus (4) (Planted)	1.40 ± 0.13b	0.23 ± 0.007a	0.54 ± 0.09e	0.99 ± 0.03d	0.27 ± 0.02d	228 ± 11a	730 ± 69e	93 ± 12a
D. turbinatus (10) (Natural)	1.52 ± 0.10b	0.23 ± 0.002a	0.61 ± 0.12e	0.93 ± 0.04d	0.36 ± 00.03b	211 ± 21a	676 ± 48e	92 ± 4a
D. turbinatus (4) (Planted)	1.41 ± 0.08b	0.23 ± 0.001a	0.72 ± 0.05e	1.00 ± 0.01d	0.27 ± 0.02d	191 ± 4b	625 ± 53e	91 ± 5a

* Figures in parentheses show the number of sites studied.

** Figures followed by the same letter in each column do not differ significantly.

E. camaldulensis (177 ppm) varied within a narrow range (191 to 228 ppm). However, there were unusually high concentration of Mn in *E. camaldulensis* (1906 ppm) and *P. caribaea* (1111 ppm). The two species also varied widely in Mn concentration in foliage among the sites. In all cases, Mn concentration was higher than that of Fe. Concentration of Zn varied from 59 ppm (*P. caribaea*) to 100 ppm (natural *D. costatus*, however, not significantly different from other Dipterocarp sites). In all the species, thus, the order of micronutrient concentration was Mn>Fe>Zn.

Similar concentrations of N, K and Mg in leaves of *A. auriculiformis* were reported by Pande *et al.* (1987) and Osman *et al.* (1992) but both of them observed less P and Ca. Considerably low concentration of N, P, and K in *P. caribaea* needles was also reported earlier (Kadeba and Aduyai, 1985). Osman *et al.* (1992) observed, however, higher N and lower P than the present values. According to Fassbander (1979) and Zech and Drechsel (1992), such low values of needle N, as observed at present are associated with chlorotic symptoms in the needles. But these symptoms were not evident in the present plantations. Nutrient concentrations of several Eucalypts have been reported from India (Pande *et al.*, 1987; Negi *et al.*, 1988; George and Varghese, 1990). The present average N value lies within their range but Ca concentration is very high in the present study. Foliar analysis data of *Dipterocarpus* species are less available in literature. Only Osman *et al.* (1992) reported foliar macronutrients of another plantation of *D. turbinalus* at Chittagong where N and K values were similar and P and Ca were much less. Since the present natural and planted trees appeared very healthy, these concentrations should be optimum.

Micronutrients of forest trees have less been studied than the major ones. A limited number of study has been carried out in some other Acacias, Eucalypts and Pines (Rogers and Westman, 1977; Richardson and Parkins, 1985; Zech and Drechsel, 1992). These species differ in the preference of Fe, Mn and Zn but the same order of the micronutrients as stated earlier was reported for *Pinus caribaea* by Zech and Drechsel (1992). However, the needles studied by them contained only 129 ppm Fe, 338 ppm Mn and 29 ppm Zn. So, all these micronutrient concentrations were higher in the present plantations.

The nutrient concentrations in leaves or needles indicate the state the nutrition needed for the physiological activity at the present state of growth. These do not show the nutrient demands of the species because nutrients mobilized or immobilized in other plant parts have not been estimated. Still, a comparison among these species is possible and speculation may be made that exotics except *P. caribaea*, (*A. auriculiformis*, *A. mangium* and *E. camaldulensis*) would require more supply of Ca and less N taking into consideration that a good proportion of N in *A. auriculiformis* and *A. mangium* would be satisfied by nodules.

Nutrient Proportions in Foliage : Some investigators (Adams and Allen, 1985; Van den Driessche, 1974) emphasized that the concentration of a nutrient element in any plant part may not depict the actual picture of its state of nutrition because of the presence of specific and non-specific interactions among different nutrients. These interactions affect the assimilation of nutrients and growth of plants. So, some nutrient ratios are shown in Table 2. The N/P ratio ranged from 3.82 (*P. caribaea*) to

Table 2

Average macronutrient ratios in leaves of six forest trees grown in Brown Hill Soils of Bangladesh

Species	N/P	N/K	P/K	K/Ca	K/Mg	K/Ca+Mg	Ca/Mg
A. auriculiformis	10.39a*	2.06a	0.20a	0.79a	2.75a	0.61a	3.51a
A.mangium	1.53a	2.70b	0.26a	0.76a	2.67a	0.59a	3.50a
E. camaldulensis	4.30b	1.12c	0.27a	0.51b	1.83b	0.40b	3.52a
P. caribaea	3.82b	2.03a	0.59b	0.36c	0.89c	0.25c	2.51b
D. costatus (Natural)	6.34c	2.61b	0.41c	0.56b	1.86b	0.43b	3.33a
D. costatus (Planted)	6.09c	2.59b	0.43c	0.55b	2.00b	0.43b	3.67a
D. turbinatus (Natural)	6.71c	2.72b	0.41c	0.65d	1.67d	0.47b	2.64b
D. turbinatus (Planted)	6.13c	1.96d	0.32c	0.72d	2.67a	0.57a	3.70a

* Figures followed by the same letter in each column do not differ significantly

10.35 (*A. mangium*). This ratio did not differ significantly between *A. auriculiformis* (10.39) and *A. mangium*, between *E. camaldulensis* (4.30) and *P. caribaea* and among the Dipterocarps (6.09 to 6.71). The N/K ratio varied between 1.12 and 2.72. The variation in this ratio was not significant among *A. mangium, D. costatus* (planted and natural) and *D. turbinatus* (natural). However, planted *D. turbinatus* differed significantly from natural *D. turbinatus*. On the other hand, there was no significant difference in P/K ratio among *A. auriculiformis, A. mangium* and among the *Dipterocarpus* spp. The P/K ratio varied from 0.20 (*A. auriculiformis*) to 0.59 (*E. camaldulensis*). The K/Ca was similar within the Acacias and between *E. camaldulensis* and *D. costatus*. *D. turbinatus* had K/Ca ratio significantly higher than *D. costatus*. The least K/Ca was in *P. caribaea*. The K/Mg ratio was similar in *A. auriculiformis, A. mangium* and planted *D. turbinatus* but significantly different from others. There was no significance difference between *E. camaldulensis* and *D. costatus*. *P. caribaea* had the least K/Mg too. The Ca/Mg ratios among *A. auriculiformis, A. mangium, E. camaldulensis, D. costatus* and planted *D. turbinatus* were not statistically different. Although the concentration of Ca in *P. caribaea* was similar to those in *D. costatus* and *D. turbinatus*, the K/Mg, K/Ca and Ca/Mg ratios indicate that *P. caribaea* needs proportionately less K and Mg but higher Ca. Kelley and Lambert (1972) suggested that plants need not only an optimum concentration of nutrients but should also have optimum nutrient ratios. An optimum ratio between two nutrients may be created in different situations, when both of them are optimum, when both are deficient or when both are in excess. So, the nutrient ratios alone also fail to show how the plants are nourished. Both concentrations and ratios are important. There are also suggestions to use concentrations of all other nutrients relative to N (Ingestad, 1979; Ericsson, 1981) for a better understanding of plant nutrition and interpretation of foliar analysis data. The average relative proportion of the macronutrients for the presently

Table 3

Proportions of other foliar nutrients relative to nitrogen in some tree species

Species	N	P	K	Ca	Mg	Fe	Mn	Zn
A. auriculiformis	100	9.47	48.56	62.55	18.11	0.84	0.85	0.34
A. mangium	100	9.62	38.91	51.46	15.06	0.91	1.67	0.33
E. camaldulensis	100	23.16	93.68	181.05	52.63	1.86	20.06	0.97
P. caribaea	100	26.03	49.32	139.73	56.16	2.95	15.22	0.81
D. costatus (Natural)	100	15.86	39.31	70.34	21.38	1.54	3.43	0.69
D. costatus (Planted)	100	16.43	38.57	70.71	19.29	1.63	5.21	0.66
D. turbinatus (Natural)	100	15.13	40.13	61.18	23.68	1.39	4.48	0.61
D. turbinatus (Planted)	100	16.31	51.06	70.92	19.15	1.35	4.43	0.65

investigated species are shown in Table 3. Data indicate that *E. camaldulensis* and *P. caribaea* had proportionately higher Ca and Mg than the other tree species. There were little differences in nutrient proportions of *D. costatus* and *D. turbinatus*. Low proportions of P relative to N in *A. auriculiformis* and *A. mangium* were the high N concentration in those leaves. Proportion of other nutrients have also been affected by N concentrations. Data in Table 3 should not, therefore, be used for comparison among the species. These only indicate range of foliar nutrient status of the investigated species encountered in the widely varied site conditions. Ingested (1979) suggested optimum macronutrient proportions of 100 N : 13 P : 65 K : 6 Ca : 8.5 Mg for Scotspine, and Adams and Allen (1985) observed average proportions of 100 N : 9.3 P : 36.5 K : 17.3 Ca : 9.2 Mg for Loblolly pine. The proportions of all other macronutrients except N in the present *P. caribaea* needles are higher than the above. This could be due to the specific preferences of nutrients of *P. caribaea* or due to low N concentration. Wheter *P. caribaea* was deficient in N or whether any other species suffered from deficiency of a particular nutrient cannot be predicted from present data. If optimum foliar nutrient concentrations/ratios/proportions had already been established earlier or if foliar analysis could be done on the basis of different growth categories, such conclusion could have been drawn. Further work is needed in this regard.

Soil Nutrient Supply : The average concentrations of total N and available P, K, Ca, Mg, Fe and Mn in soils of 0 to 75 cm depth under different species are given in Table 4. Total N varied from 36 to 56 mg/100 g, P from 0.10 to 0.16 mg/100 g, K from 2.66 to 4.99 mg/100 g, Ca from 2.72 to 4.89 mg/100 g, Mg from 2.01 to 2.77 mg/100 g, Fe from 1.39 to 1.76 mg/100 g and Mn from 1.31 to 1.84 mg/100 g. The soils under Dipterocarps had less total N and available Mn but higher K, Ca and Mg. These may not necessarily reflect the effect of the tree species because the Dipterocarp sites were located within limited area of Dulahazara. These differences in soil properties may also inherit from parent materials. The soils have been developed from tertiary sediments, mostly unconsolidated and occasionally consolidated (Anon., 1976).

Table 4

Average concentration (mg/100g) of Total N and available P,K,Ca,Mg,Fe and Mn in soils (mean of 0 to 75 cm depth ± SD) under different tree species

Species	Available nutrients						
	Total N	P	K	Ca	Mg	Fe	Mn
Acacia auriculiformis	48 ± 6a*	0.11 ± 0.03a	3.21 ± 0.72a	2.72 ± 1.20a	2.01 ± 0.53a	1.44 ± 0.28a	1.84 ± 0.56a
Acacia mangium	56 ± 8a	0.10 ± 0.04a	4.07 ± 1.23a	3.12 ± 1.28b	2.77 ± 1.62b	1.39 ± 0.42a	1.59 ± 0.38b
Eucalyptus camaldulensis	52 ± 7a	0.14 ± 0.05a	3.93 ± 2.47a	4.04 ± 2.86c	2.06 ± 1.10a	1.76 ± 0.36b	1.82 ± 1.10a
Pinus caribaea	49 ± 10a	0.15 ± 0.03a	2.66 ± 0.86b	2.48 ± 1.11a	2.14 ± 0.76a	1.43 ± 0.34a	1.63 ± 0.78b
Dipterocarpus costatus (Planted)	39 ± 3b	0.14 ± 0.04a	4.99 ± 3.31c	4.99 ± 3.39d	2.56 ± 1.46c	1.60 ± 0.52b	1.42 ± 0.58c
Dipterocarpus turbinatus (Planted)	40 ± 4b	0.12 ± 0.02a	4.93 ± 3.34c	4.72 ± 3.59d	2.72 ± 1.58b	1.45 ± 0.61a	1.38 ± 0.61c
D. Costatus + *D. turbinatus* (Natural, Mixed)	36 ± 12b	0.16 ± 0.08a	4.67 ± 2.21c	4.89 ± 2.13d	2.48 ± 1.31c	1.58 ± 0.43b	1.31 ± 0.54c

*Figures followed by the same letter in each column do not differ significantly.

These are moderately to excessively surface drained due to rains and slope. However, the soils appear to be very poorly fertile by agricultural standard (Anon., 1989). Since *D. turbinatus* and *D. costatus* occur naturally in this area, they may be considered to be low nutrient demanding and to have adapted in nutrient poor soils. Moreover, growth of *A. auriculiformis* and *A. mangium* suggests them to be suitable for these soils too.

Soil Tree Nutrient Relationship : The relationship between availability of nutrients in soil and the concentration of these nutrients in tree leaves were examined by correlation studies. None of the correlation co-efficients for any species was significant. So, these are not given here. However, an absence of correlation may be the result of several factors :

(1) The chemical methods of available soil nutrient extraction may not correspond to the physiological processes of nutrient uptake by trees; these methods were based on nutrient recovery by agricultural crops;

(2) The roots of the plants may extend to deeper soil than sampled (Evans, 1980); distribution of effective roots may be different at different soil depths; mean values of a particular depth may not represent the nutrient supply to the roots;

(3) Forest trees are long duration plants and during the past period of growth nutrient are recycled (Sugur, 1989; George and Varghese, 1990) and retranslocated (Helmisaari, 1992) several times; so, nutrient flow rather than soil nutrient availability and foliar nutrient level may be more indicative, and

(4) Due to nutrient interaction both in leaf and soil, relationship becomes complicated (Adams and Allen, 1985).

In the present study Ca in *A. mangium* leaf and K in *P. caribaea* needle were negatively correlated with K/Ca ratio of soil. The correlation co-efficients were -0.9117 (df=8, significant at 1%) and -0.9070 (df=4, significant at 5%) respectively. This indicated antagonism between available K and Ca of soil for these two species. Van den Driessche (1976) observed reduction of foliar Mg by increasing supply of K and Wells (1970) reported that K fertilization decreased both Ca and Mg in Loblolly pine needles.

Thus, this study gives some indication of the state of nutrition of some forest tree species getting priorities in plantation programmes. Nutrient levels of these species in the country and particularly of *D. turbinatus* and *D. costatus* even outside the country has little been reported. The information is vital in selecting species, maintaining natural fertility of soils and increasing productivity of plantations through nutrient management.

SUMMARY

In the present investigation, foliar concentrations of N, P, K, Ca, Mg, Fe, Mn and Zn in two indigenous - *Dipterocarpus costatus* Gaertn F. and *Dipterocarpus turbinatus* Gaertn F. and four exotic forest tree species - *Acacia auriculiformis* A. Cunn. Ex. Benth., *Acacia mangium* Willd., *Eucalyptus camaldulensis* Dehnh. and *Pinus caribaea* Morelet. var. *hondurensis* Barr. and Golf.

were determined. There was high variability in foliar K, Ca and Mn but low in P concentrations among the species. Within species variability was generally less than that between species. Foliar nutrients were not found to be correlated with soil nutrient supply.

बांगला देश की भूरी पर्वतीय मृदाओं में उग रही छह वन वृक्षजातियों की पत्तियों के पोष्याहार

के०टी० उस्मान व एम० सिकंदर

सारांश

प्रस्तुत अन्वेषण में, पत्तियों में नाइट्रोजन, फास्फोरस, पोटाशियम, कैलशियम, मैगनीशियम, लौह, मैंगनीज और जस्ता संकेन्द्रणों को दो देशज - *डिप्टेरोकार्पस कौस्टेटस* गार्टन वत्स व *डि० टर्बिनेटस* गार्टन वत्स तथा चार परदेशीय वन वृक्ष जातियों - *अकेसिया औरिकुलिफॉर्मिस* ए० कनि० निषेध बेन्थ० *अ० मैंगियम* विल्डे०, *युकेलिप्टस कैमेल्ड्युलेंसिस* डेहनेह और *पाइनस कैरिबिया* मोरलेट विभेद *हौण्डुरेंसिस* बार्र व गोल्फ में विनिश्चित किया गया । विभिन्न जातियों की पत्तियों के पोटाशियम, कैलशियम और मैंगानीज में सार्थक विभिन्नता तथा फास्फोरस संकेन्द्रण में कम विभिन्नता देखी गई । एक ही जाति के अन्दर विभिन्नता भिन्न-भिन्न जातियों के अन्दर की विभिन्नता से सामान्यत: कम रही । पत्तियों के पोष्याहार मृदा के पोष्याहारों के साथ सहसम्बन्धित नहीं पाए गए ।

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SOME NEW DISEASES OF *ALBIZIA* SPECIES FROM INDIA

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Introduction

During periodic monitoring of diseases in forest nurseries in Uttar Pradesh, seedlings of *Albizia lebbek, A. procera* and *A. chinensis* were found attacked by fungi hitherto unrecorded on these hosts causing leaf spot and stem necrosis (Mehrotra *et al.*, 1992; Bilgrami *et al.*, 1991). The pathogens were studied and are described herein as they occurred on new hosts.

Alternaria alternata (Fr. Keissler)

Alternaria leaf spot of *A. procera* and *A. lebbek* appeared in the month of October and the pathogen remained quite aggressive all through December-January. Disease evaluation showed 25% incidence in Lacchiwala and 15% in Kalsi in a seedling stock of 25,000 and 10,500 respectively.

Infection spots greyish brown to dark brown or blackish, circular to irregular, linear on stem and petioles, initially minute later coalesce to form bigger spots. Conidiophores single or in groups, simple or branched, pale to olivaceous brown, septate, smooth, upto 55µm long, 3-5 µm thick with one to several conidial scars. Conidia formed in long, often branched chains, obclavate or pyriform, ovoid or ellipsoidal, pale to mid-golden brown, smooth, upto 8 transverse and usually several longitudinal or obliquely septate, overall length 20-63 µm, 9-18 µm, thick at the broadest part, often with short conical or cylindrical beak pale in colour, 2-5 µm thick. DIS. Herb. 460.

Alternaria cassiae Jurais and Khan

One year old seedlings of *A. procera* were found attacked by *A. cassiae* causing severe leaf spot. Over 50% disease incidence was recorded with moderate to high intensity in 5,500 seedlings in Satiwala nursery, Dehra Dun.

Infection spots greyish brown to irregular, linear on stem and petioles, initially minute, later coalesced to form bigger spots. Conidiophores, single or in groups, simple or branched, septate, olivaceous brown, 33-56 x 7.6-10.2µm. Conidia pale yellow to olivaceius brown, obclavate, smooth, in chains with 3-10 transverse septa and 4-5 longitudinal septa, 31-115.2 x 17.9-25.6 µm, beak septate, swollen at apex with a prominent scar. DIS. Herb. 415. IMI. 317732.

Pleiochaeta setosa (Kirchn) Hughes (Syn. _Pleiochaeta albiziae_ (Petch) S. Hughes

Moderate to high incidence of *Pleiochaeta* leaf spot was recorded in *A. lebbek* seedlings in Dehra Dun Forest Division nurseries during August-September.

Infection spots dark brown, minute, enlarge gradually coalesce and form irregular patches, slightly sinking centrally become light brown with 1-2 pale yellowish concentric zones, surrounding areas become chlorotic and such leaf-lets shed prematurely. Conidiophores, pale oblivaceous, simple, upto 140 µm long; conidia dark, mostly 5-septate, rarely 8 septate, 55-92 x 13-23 µm, cylindrical to ellipsoidal sometimes slightly curved, bearing one to three long slender, apical, hyaline appendages, upto 90 µm long, 2-4 µm thick at the base. DIS Herb. 418. IMI. 318742.

Epicoccum nigrum Link

Light to moderate incidence of *Epicoccum* leaf spot was observed in *A. lebbek* seedlings in Dehra Dun nurseries. Leaf spots start appearing in the month of February and persist up to March. Infection initiates from the margin of the leaves and gradually the entire leaf surface is invaded. Raw number areas surrounded by antimony yellow coloured tissue develop. The diseased tissue finally dry up.

Sporodochia black, upto 2 mm dia, more or less cushion shaped. Conidiophores 4-16 x 2.5-6.5 µm, compact or loose, dark, conidia dark, several celled, globose, 12-30 µm (-40 µm).

Periconia sp. Tode ex Schw

Periconia leaf spots were recorded on *A. lebbek* during monsoon season. An assessment of 15,000 seedlings at Lacchiwala, 10,000 at Kalsi and 2,000 at Barth nurseries showed 15% and 5% disease incidence respectively.

Infection spots appear as a small pin head size in the beginning, later becoming large with irregular margin, white papery in the centre with blackish margins on the upper surface, yellowish brown on the lower surface, conidiophores dark brown, upright present on either leaf surface, abundant on the lower surface, 1-3 septate, broader at the base, 212-400 x 10 µm; conidia dark, globose, 1-celled, verucose, 13.8 x 154.4 µm.

Cephalosporium sp. _Corda_

An incidence of 55% of stem necrosis caused by *Cephalosporium* sp. was recorded in Lacchiwala nursery, Dehra Dun Forest Division. The disease appeared during the rainy season causing severe damage to the nursery stock.

Infection spots on the stem circular to irregular, first greyish to light brown with dark margin spores produced in mass in rainy season as whitish to light pink spore mass in drops. Mycelium often spread beyond necrotic spot filling the bark crevices. The cambium is killed in the necrotic zone and the bark flaked off resulting in girdling and death of the plant above the girdled region. Affected seedlings are eventually killed. Infection spots and necrosis was also observed on the rachis and rachilla of the leaves resulting in premature defoliation. Conidiophores slender, sometime swollen, simple; conidia hyaline, 1-celled, DIS Herb. 488.

Acknowledgements

Authors are grateful to Dr. P.M. Kirk and Mr. J. David, Commonwealth Mycological Institute Surrey, England for identifying *Pleiochaeta setosa* and *Alternaria cassiae* respectively.

SUMMARY

Five foliage pathogens namely, *Alternaria alternata* on *Albizia lebbek* and *A. procera; Alternaria cassiae, Pleiochaeta setosa, Epicoccum nigrum* and *Periconia* sp. on *Albizia lebbek* causing leaf spots and a *Cephalosporium* sp. causing stem necrosis of *Albizia chinensis* are described as they occur on new hosts.

भारत से मिली *एल्बीजिया* की जातियों के कुछ नये रोग

एस०एन० खान व बी०एम० मिश्र

साराशं

पत्तियों के पाँच रोग जन, *आल्टरनेरिया आल्टरनेटा, एल्बीजिया लेब्बेक* और *ए० प्रोसेरा* पर *आल्टरनेरिया कैसिई, प्लेइआकीटा सेटोसा, एपिकोक्कम नाइग्रम* और *पैरिकोनिया* की जाति *एल्बीजिया लेब्बेक* पर पर्ण लांछन बनाती तथा *केफालोस्पोरियम* की जाति *एल्बीजिया चायनेसिस* के स्तम्भ का परिगलन करती वर्णित की गई हैं क्योंकि ये नये पोषी पादपों को हानि पहुंचाती पाई गई है ।

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DEINKING AND BLEACHING OF OLD NEWSPRINT

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Introduction

One of the main household wastes, newsprint could be a source of recycled fibres, if adequate level of brightness is achieved for its use in magazines and newsprint. Pigments of printing ink in newsprint could be removed effectively by flotation or washing as these are water insoluble substances (Maurice, 1992). Caustic soda although makes the fibres more flexible and also helps in removing the ink, but it also causes alkali darkening or undesirable yellowing of the pulp furnish containing fairly good amount of mechanical pulp (Fergusan, 1992). Therefore, in continuation of our earlier studies on deinking of waste paper, magazine and old office waste (Srivastava *et al.*, 1999), an attempt has been made to deink the old newsprint and bleach the deinked newsprint pulp to increase its fibre value.

Experimental

Deinking of newsprint : Six months old newsprint collected from ICFRE Library was disintegrated in a laboratory hydrapulper for 10 minutes at ambient temperature. After 10 minutes, steam was injected into hydrapulper to raise the temperature to 70°C and pulp was cooked for 45 minutes at 8% consistency after adding the deinking chemicals (Table 1). Deinked pulps were washed thoroughly with water and pulp yield was determined, in each case.

Bleaching of deinked pulps : Each deinked pulp was bleached using calcium hypochlorite (2% as available chlorine). Treatment was given at 40.0 ± 2.0°C for 60 minutes at 8% consistency. pH 10.5 ±0.5 was maintained throughout the treatment. Pulp sheets of about 65 ± 2 gsm of these pulps were made and tested for brightness.

Maximum brightness gain on hypochlorite bleaching was observed in pulp deinked using 1.5% Na_2CO_3 and 2% Nirma, a commercial detergent available in open market at the rate of Rs. 18.00 per kg. Thus, it was bleached by mono-stage hydrogen peroxide (P) and also by calcium hypochlorite followed by hydrogen peroxide (ie. H/P). P stage bleaching was carried out at 68 ± 2°C at 8% consistency using 2.0% hydrogen peroxide (as available hydrogen peroxide), 1.0% sodium hydroxide, 2.0% sodium silicate, 0.25% magnesium sulphate and 0.10% sodium salt of Ethylene Diamine Tetra Acetic acid (EDTA). pH 10.0 ± 0.5 was maintained throughout the treatment. In H/P bleaching, hypochlorite treatment

Table 1

Pulp yield and brightness of deinked and hypochlorite bleached deinked pulps

Sl. No.	Chemical added, %				Pulp yield, %		Brightness, % ISO		
	Sodium salt of benzene sulphonic acid	NaOH	Na_2CO_3	Detergent	Before bleaching	After bleaching	Before bleaching	After bleaching	Gain % ISO
1	2.0	—	—	—	85.50	81.17	40.16	41.67	1.51
2	2.0	1.5	—	—	82.09	79.48	39.62	40.77	1.15
3	2.0	—	1.5	—	83.37	79.57	40.29	42.28	1.99
4	—	—	—	2.0	85.73	81.35	42.00	43.50	1.50
5	—	1.5	—	2.0	82.78	79.67	41.55	42.54	0.99
6	—	—	1.5	2.0	83.16	79.82	42.38	46.77	4.49

Pulp yield based on o.d. newsprint.

was given under the identical conditions mentioned above. In P stage bleaching, only 1.0% hydrogen peroxide (as available hydrogen peroxide) was used. Other conditions were identical as mentioned above. Bleached pulps were washed and pulp yield was determined.

Beating, sheet making and evaluation of bleached pulps : These pulps were beaten in Lampen mill to freeness of about 250 ± 25 (ml) CSF. Standard hand sheets of about 65 ± 2 gsm were made on a Standard British Sheet Making machine, conditioned at 27 ± 2°C and 65 ± 2% relative humidity and tested for physical properties and brightness.

Blending of bleached newsprint pulp with bleached bamboo pulp : Pulp bleached with hydrogen peroxide exhibited maximum brightness gain over other bleaching sequence(s). Therefore, the pulp was beaten to freeness 250 ml (CSF) and blended with bleached bamboo pulp beaten to freeness 250 ml (CSF) in different ratio to achieve acceptable level properties for different variety of papers for different end uses.

Results and Discussion

Effect of deinking chemicals and H stage bleaching on pulp yield and brightness : Unbleached pulp yield (85.6 ± 0.12%) and unbleached pulp brightness (41.08 ± 0.92% ISO) and bleached pulp yield (81.27 ± 0.09%) and bleached pulp brightness (42.59 ± 0.92% ISO) were comparable for old newsprint deinked with sodium salt of benzene sulphonic acid (2.0%) and Nirma, a commercial detergent (2.0%) available in open market at the rate of Rs. 18.0 per kg (Table 1). On addition of sodium hydroxide (1.50%) or sodium carbonate (1.50%) along with sodium salt of benzene sulphonic acid and commercial detergent, separately, drop in pulp yield was 2 to 3%. Unbleached pulp yield 82.44 ± 0.35% and 83.27 ± 0.11%; bleached pulp yield, 79.58 ± 0.10% and 79.70 ± 0.13%, respectively, for pulps deinked with the addition of sodium hydroxide and sodium carbonate along with

Table 2

Physical strength properties and brightness of bleached newsprint

Properties	Deinked pulp	Bleaching sequence of deinked pulp		
		P Stage	H Stage	H/P Stage
Pulp yield, %	83.16	80.27	79.82	78.01
Tensile index, Nm/g	24.30	28.62	22.92	24.52
Burst index, $kPam^2/g$	1.20	1.41	1.25	1.23
Tear index, mNm^2/g	1.77	2.02	1.79	1.81
Pulp brightness, % ISO	42.38	51.02	46.77	48.26

Note : Pulp corresponds to Sl. No. 6 of Table 1. Pulp yield based on o.d. newsprint basis

sodium salt of benzene sulphonic acid (2.0%) and commercial detergent (2.0%) was also almost the same. However, slightly lower pulp yield in case of sodium hydroxide addition as compared to sodium carbonate may be attributed to higher alkalinity of sodium hydroxide as compared to sodium carbonate. In general, the brightness (41.00 ± 1.38 ISO) of unbleached pulps was also the same for all the pulps. However, the brightness gain was highest (4.49% ISO) in case of sodium carbonate (1.5%) and commercial detergent (2.00%) de-inked pulp. Hence subjected to further studies. The pulp exhibited tensile index (Nm/g), 24.30; burst index ($kPam^2/g$), 1.20 and tear index (mNm^2/g), 1.77 (Table 2).

Effect of P, H and H/P bleaching stages on pulp yield, strength properties and brightness of deinked pulp : Pulp deinked using detergent (2.00%) and sodium carbonate (1.50%) corresponding to Sl. No. 6 of Table 1 was also bleached adopting mono stage hydrogen peroxide (P), H stage and followed by H/P sequence (Table 2). Results recorded revealed that the bleached pulp yield was 80.27%, 79.82% and 78.01%; tensile index (Nm/g), 28.62, 22.92 and 24.52; burst index ($kPam^2/g$), 1.41, 1.25, 1.23; tear index (mNm^2/g), 2.02, 1.79 and 1.81 and brightness 51.03%, 46.77% and 48.26% ISO respectively for deinked pulp bleached by P, H and H/P bleaching sequence(s) (Table 2). These results indicated that the pulp bleached by hydrogen peroxide possessed superior strength properties and higher brightness. Thus chosen for blending studies.

Blending of bleached deinked pulp with bamboo bleached pulp : Hydrogen peroxide bleached pulp possessing superior strength properties and higher brightness as compared to H stage and H/P stage was blended with bleached bamboo pulp. It was observed that the strength properties and brightness were increased, consistently, with the increase in ratio of bleached bamboo pulp in the pulp furnish, as expected (Table 3). However, gain in tear index (mNm^2/g) and brightness % (ISO) was more pronounce as compared to tensile index (Nm/g) and burst index ($kPam^2/g$).

Conclusion

On the basis of above observations, it was concluded that the brightness gain

Table 3

Blending ratio, strength properties and brightness of pulp sheets

Blending ratio (BDN : BBP)	Tensile index (Nm/g)	Burst index ($kPam^2/g$)	Tear index (mNm^2/g)	Brightness (% ISO)
00 : 100	32.45	2.07	4.85	70.53
20 : 80	32.06	1.76	4.03	64.92
40 : 60	31.48	1.69	3.29	57.48
60 : 40	30.71	1.55	2.77	55.95
80 : 20	29.80	1.49	2.31	53.34
100 : 00	28.62	1.41	2.02	51.03

BDN and BBP stands for bleached de-inked newsprint pulp of Table 2 and bleached bamboo pulp, respectively.

was higher for old newsprint deinked using Nirma, a commercial detergent (2.00%) available in open market at the rate of Rs. 18.0 per kg and sodium carbonate (1.50%) as compared to newsprint deinked using commercial detergent alone or with sodium hydroxide and also deinked with sodium salt of benzene sulphonic acid alone or in combination with sodium carbonate or sodium hydroxide at almost comparable level of pulp yield. P stage bleaching of the above pulp produced pulp possessing superior strength properties coupled with higher brightness as compared to H and H/P bleaching sequence(s). On blending the pulp with bleached bamboo pulp in different ratio, the strength properties and brightness of the resulting pulp furnish improved consistently, hence a particular blending ratio may be chosen to make a paper of adequate properties desired for the end use.

SUMMARY

Old newsprint were deinked using sodium salts of benzene sulphonic acid (2.00%) and Nirma, a commercial detergent (2.00%) available in open market at the rate of Rs. 18 per kg, alone and with the addition of sodium hydroxide (1.50%) or sodium carbonate (1.50%), separately. Each pulp was bleached using mono stage calcium hypochlorite. Unbleached and bleached pulp yield and brightness of the pulps were almost comparable, except marginally higher pulp yield for newsprint deinked with sodium salt of benzene sulphonic acid or commercial detergent, alone. Bleaching of pulps revealed that the highest brightness could be achieved in case of detergent and sodium carbonate deinked pulp, thus the pulp was also bleached by P and H/P bleaching sequence(s). It was observed that P stage bleached pulp possessed better strength properties and higher brightness than pulp bleached using other two bleaching sequences. On blending the pulp with bleached bamboo pulp in different ratio, the strength properties and brightness of the resulting pulp furnish improved consistently, hence a particular blending ratio may be chosen to make a paper of adequate properties desired for the end use.

पुराने अखबारी कागज की स्याही दूर करना और उसका श्वेतन

अनिता श्रीवास्तव व के०एस० भण्डारी

सारांश

बेंजीन सल्फोनिक अम्ल (2.00%) के सोडियम लवण और निरमा, जो व्यापारिक प्रक्षालन पदार्थ है और बाजार से 18 रू० प्रति किलो की दर से मिल जाता है, को अकेले तथा उनमें सोडियम हाइड्राक्साइड (1.50%) अथवा सोडियम कार्बोनेट (1.50%) पृथक-पृथक मिलाकर पुराने अखबारी कागजों की स्याही निकाली गई। प्रत्येक लुगदी एकल चरण द्वारा कैलशियम हायपोक्लोराइट उपयोग में लाकर श्वेतित (या विरंजित) की गई। अश्वेतित और श्वेतित लुगदी की प्राप्ति और चमक लगभग एक जैसी ही थी सिवाए इस बात के कि बेंजीन सल्फोनिक अम्ल के सोडियम लवणों से स्याही निकाले गए कागजों की लुगदी की प्राप्ति निरमा से स्याही निकाले कागजों की लुगदी की प्राप्ति से थोड़ी ज्यादा थी। लुगदियों के श्वेतन से पता लगा कि सर्वाधिक चमक प्रक्षालक और सोडियम कार्बोनेट मिलाकर स्याही निकाली लुगदी से प्राप्त की जा सकती है, इस तरह मिली लुगदी को फास्फोरस और हाइड्रोजन/फास्फोरस श्वेतन अनुक्रम से श्वेतित किया गया। देखा यह गया कि फास्फोरस चरण से श्वेतित लुगदी में शक्ति विशेषताएँ अधिक अच्छी हैं तथा अधिक चमक भी बमुकाबले अन्य दो श्वेतन अनुक्रम अपनाकर श्वेतित की गई लुगदी के भिन्न-भिन्न अनुपात में श्वेतित बांस लुगदी के साथ मिलाकर समिश्रण करने पर परिणामी लुगदी की शक्ति विशेषताओं और चमक में और अच्छा सुधार आ गया, इसलिए अन्तिम उपयोग को ध्यान में रखकर वांछित अच्छी विशेक्षताओं वाला कागज तैयार करने के लिए समिश्रण अनुपात का उचित चुनाव किया जा सकता है।

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BENEFIT - COST ANALYSIS OF AGRO-FORESTRY TREES IN ERODED SOILS - A CASE STUDY OF UPPER - SWAN CATCHMENT IN DISTRICT UNA (H.P.)

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Introduction

The Forest Survey of India estimates the country's forest cover to be 63.34 million hectare (Anon., 1997). This 19.27 per cent of the area under forests and is far below the desired forest cover. The Forest Policy of 1988 stipulates that one third of the total area in the country should come under forest cover. To meet growing forest tree based needs of the people, agro-forestry has been found to be the right answer (Arnold, 1984; Cheema and Sahota, 1987; Rana, 1995 and Rana *et al.*, 1996).

Establishment of successful agro-forestry plantations on fragile and degraded sites, such as eroded soils, is a difficult job. Under normal conditions the cost of plantations is not as high as in difficult sites. Hence, it is of paramount importance to analyse and estimate the costs and benefits of plantations raised under difficult conditions. This not only supplies information on the problems faced by the farmers who raise plantations on their degraded land but also serves as a tool to clearly know the financial worth of plantation to be raised over a given period. On the broader policy front this information can be useful in formulating various forestry development intervention programmes for such area.

Una District of Himachal Pradesh, forming a part of lower Shivaliks, comprises of 1540 km^2 geographical area and 430 km^2 (28.6%) net cultivated area (Bhat, 1997). This district lies in Himalayan foothills zone surrounded by plains of Punjab in the West and Solansinghi Dhar (mountain range) in the East. This district is in the South-western part of Himachal Pradesh and lies within 31° 21' to 31° 50' North latitude and 71° 55' to 76° 28' East longitudes (Bhat, 1997). The altitude of the district varies from 335 m at Sandohgarh to 976 m at Chintpurni temple. The annual rainfall is 1000 mm. A major portion (75%) of precipitation is received during monsoon period from June-September. Over the years, due to heavy deforestation in the catchment area and loose soil strata the problem of soil erosion has become very intense. The heavy silt load coming alongwith fast running rain water in Swan

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river and its several tributaries starts settling in the river bed as it reaches comparatively plain area. With the result river has become shallow and its spread had increased many-folds.

This river frequently changes its course leading to further deterioration in the situation. As a direct consequence of this, the destruction of vegetation and severe losses to the farmers, who grow agricultural crops on or near the banks of this river and its tributaries, have been reported. In the devastating floods of 1988 monsoon this river caused huge losses to roads, bridges, buildings, livestock and human life. In catchment area, trees check soil erosion, regulate hydraulic cycle and moderate floods.

Large scale plantation on the banks of Swan river and its tributaries and catchment area can check soil erosion and frequent change of the course of the river. Moreover standing trees retard the fast flow of river and help the silt to settle on its banks making the river-bed deeper. Such plantation programmes, besides conserving farmers' land, will also generate other environmental benefits. But plantation programmes being costlier and relatively difficult than on normal soils, discourage farmers to adopt the same. The slow growth and high mortality of plantations further decrease benefits to the farmers.

For successful implementation of plantation programmes in eroded soils such as the Upper-Swan river basin in Una District, it is important to estimate the costs and benefits of plantations including general benefits of plantations. Keeping in view above factors, the present study was undertaken to examine the existing plantation pattern of agroforestry trees and to undertake benefit-cost analysis of such plantations in the Swan catchment.

Methodology

Selection of Sample

Five villages falling the purview of eroded soils of Swan river were selected using probability proportional to the area under eroded soils. Out of five selected villages, eighty farmers were selected, again using probability proportional to the area under eroded soils. The details of finally selected sample are given in Table 1.

Table 1

Village-wise details of the sample in eroded area

Sr.No.	Name of selected village	No. of farmers interviewed
1.	Abheypur	12
2.	Nakroh	18
3.	Tunkhari	12
4.	Gondpur Banehra	14
5.	Fatehpur	24
	Total	80

Data Collection

Data were collected on pre-tested schedules specially designed for the study. The primary information recorded on such schedules was farmers' responses and judgement revealed in personal interviews. The data were collected during the financial year 1997-98.

Selection of Species

The most important agro-forestry tree

species in the study area were selected through people's perception. The four selected agro-forestry species were *Dalbergia sissoo; Albizia lebbek; Toona ciliata* and *Grewia optiva*.

Analytical Framework

The data collected on pre-tested and revised schedules during personal interviews with the farmers were arranged in tabular form. Information presented in the table represents average values.

Forest tree planting being a long gestation venture, where heavy costs are incurred in initial years and benefits are realised after many years. In this situation one cannot go for comparing benefits and costs until they are discounted and brought to a common year say at the beginning of the project (Ahmed, 1989; Akachuku, 1985; Betters, 1988; Hoekstra, 1987 and Reddy and Korwar, 1985). For this purpose Benefit-Cost ratio analysis and Net Present Worth analysis were done. Benefit-Cost analysis was done assuming a guiding rate of return equal to 12 per cent. The rationale for this rate was that, at the time of survey, farmers were getting funds for this purpose at 12 per cent rate of interest.

Benefit-Cost ratio (B-C ratio) of plantation was calculated by dividing the net present benefits by the net present costs of plantations of a particular species. The Net Present Worth (NPW) of plantation on the other hand, was calculated by subtracting net present costs out of net present benefits. Benefit-Cost analysis was done for 100 trees rather than per hectare basis. However, the environmental and social benefits of trees were not incorporated in the Benefit-Cost analysis. Similarly, no cost of land was included while calculating the cost of plantations. The net present benefits and net present costs are calculated as under :

$$B_{t0} = \sum_{t=1}^{n-1} \frac{B_t}{(1+r)^t} \quad \text{and}$$

$$C_{t0} = \sum_{t=1}^{n-1} \frac{C_t}{(1+r)^t} \quad \text{and}$$

Where :

B_{t0} and C_{t0} are net present benefits and net present costs

B_t and C_t are benefits and costs in the year t

r = guiding rate of returns

n = rotation of the tree species in years

A plantation is beneficial or worth establishment if the corresponding net present worth value comes to be positive or benefit cost ratio more than one.

Valuation of Benefits

1. *Fuelwood* : Since fuelwood was marketed in all the villages of the study area, hence its valuation was done on the basis of market price minus cost of transporting the fuelwood upto the market.

2. *Tree leaf fodder* : In none of the selected villages tree leaf fodder was sold on weight basis i.e. Rs./qtl. while in the entire study area such fodder was sold and bought on the basis of foliage on the standing trees. The tree leaf fodder was valued on the basis of prevalent average market price for the trees of a specific size, age, site and species.

3. *Timber* : Trees were sold and bought for timber in all the villages under study.

Timber of different species was valued on the basis of average sale price of a tree of given age and species minus value of fuelwood, pole, fencing material etc. obtained from that tree.

4. *Others* : Other benefits like fencing material and fibre from forestry trees were valued on the basis of opportunity cost of time for procurement of that material from the alternate source.

Results and Discussion

Land holding

Village-wise details of total land, eroded land and plantations in eroded lands has been given in Table 2. Household averages are presented in the parentheses. It is evident from the table that on an average number of planted trees of selected species per household varied from 26.4 in Fatehpur village to 43.5 in Gondpur Banehra village.

Plantations on different sites

The study area was divided into grass lands, borders and paths and barren land. Plantation on borders or field bunds as well as along paths was common in all the villages of the study area. The most frequent plantation was found to be in grasslands followed by plantations on barren lands and borders and paths. In surveyed villages, 2,798 agro-forestry trees were found planted in eroded land. Out of this 1,939 were on grasslands, 603 were on barren land and 256 were on borders and paths (Table 4). Per household average contribution of agro-forestry trees on grasslands, borders and paths and barren lands was 24.24, 7.54 and

Table 2

Village-wise details of total land holding, eroded land and plantations of selected trees in the eroded area

Village	Total land (ha)	Eroded land (ha)	Plantation on eroded land (No. of trees)
Abheypur	30.5 (2.54)	3.36 (0.28)	438 (36.5)
Nakroh	54.0 (3)	6.48 (0.36)	620 (34.4)
Tunkhari	32.8 (2.73)	4.26 (0.35)	497 (41.4)
Gond. Banehra	44.8 (3.2)	5.37 (0.38)	609 (43.5)
Fatehpur	71.6 (2.98)	7.88 (0.32)	634 (26.4)
Total	233.8 (2.92)	27.35 (0.34)	2798 (35.0)

Note : Figures in the parenthesis correspond to the average of households

Table 3

Village-wise distribution of number of trees of selected species in eroded areas

Village	Species				Total
	D. sissoo	*A. lebbek*	*T. ciliata*	*G. optiva*	
Abheypur	159 (13.25)	72 (6.00)	89 (7.42)	118 (9.83)	438 (36.50)
Nakroh	224 (12.44)	85 (4.72)	78 (4.33)	233 (12.94)	620 (34.44)
Tunkhari	178 (14.83)	59 (4.92)	71 (5.92)	189 (15.75)	497 (41.42)
Gond. Banehra	239 (17.07)	92 (6.57)	57 (4.07)	221 (15.79)	609 (43.50)
Fatehpur	218 (9.08)	79 (3.29)	94 (3.92)	243 (10.12)	634 (26.42)
Total	1018 (12.72)	387 (4.84)	389 (4.86)	1004 (12.55)	2798 (34.98)

Note : Figures in the parenthesis correspond to the averages of households

Table 4

Species-wise details of number of trees planted on different sites in eroded soils

Site	Species				Total
	D. sissoo	*A. lebbek*	*T. ciliata*	*G. optiva*	
Grassland	654 (8.17)	278 (3.48)	214 (2.67)	793 (9.91)	1939 (24.24)
Border and Path	161 (2.01)	89 (1.11)	152 (1.90)	201 (2.51)	603 (7.54)
Barren land	203 (2.54)	20 (0.25)	23 (0.29)	10 (0.13)	256 (3.20)
Total	1018 (12.72)	387 (4.84)	389 (4.86)	1004 (12.55)	2798 (34.98)

Note : Figures in the parenthesis correspond to the average of households

3.20, respectively. Number of agro-forestry trees has been discussed for total sampled households, per household, species-wise or site-wise instead of per hectare basis.

Plantations of different species

It can be observed from Table 4 that out of the total of 2,798 agro-forestry trees

Table 5

Year-wise detailed cost of plantation of Dalbergia sissoo in eroded soils (Rs / 100 trees)

Particulars	Years									Total
	1	2	3	4	5	6-10	11-20	21-24	25	
Costs :										
Plantation costs	1163	306								1469
Maintenance operations	359	138	103	212	202	823	1431	118	-	3386
Miscellaneous and harvesting	141	68	47	49	57	203	574	309	679	2127
Total cost	1663	512	150	261	259	1026	2005	427	679	6982
Benefits :										
Fuelwood	-	-	-	593	776	3288	7035	531	11050	23273
Timber	-	-	-	-	-	-	-	-	60500	60500
Total benefits	-	-	-	593	776	3288	7035	531	71550	83773
Discounted costs @ 12% pa	1663	457	120	186	165	464	388	40	45	3528
Discounted benefits @ 12% pa	-	-	-	424	494	2094	1361	49	4717	9139

NPW = Rs 9139 - Rs 3528 = Rs 5611

$$\text{B-C ratio} = \frac{\text{Rs } 9139}{\text{Rs } 3528} = 2.59$$

Note : 1. Plantation costs include costs of seedlings, site clearance, pit digging and filling etc.
2. Maintenance costs include costs of pruning, lopping, fencing and fence repairs etc.

maximum (1,018) were that of *D. sissoo* followed by *G. optiva* (1004), *T. ciliata* (389) and *A. lebbek* (387). Species-wise average number of agro-forestry trees planted by every household of different villages can also be observed from Table 3.

Benefit-Cost analysis

1. *Dalbergia sissoo* (Shisham) : *D. sissoo* is an important tree species of the study area. It meets fuelwood, timber needs of the farmers and assists in soil amelioration/ conservation.

The total discounted cost of raising the plantation of 100 trees of *D. sissoo* came out to Rs. 3,528 of which a major portion of expenditure (Rs. 1,663) was incurred in first year of plantation which amounted to 47.14 per cent of the total cost. In 2nd year and from 6th to 10th year a discounted cost of Rs. 457 and 464 was incurred in the establishment and maintenance of the plantation. It is to be noted that the major costs during 1st and 2nd year of plantation attributed to the plantation cost which included cost of seedlings, site clearance, pit digging and refilling while the cost of maintenance including lopping for fuelwood was major cost component for the remaining period of the plantation.

Table 6

Year-wise detailed cost of plantation of Albizia lebbek in eroded soils (Rs/100 trees)

Particulars	Years								Total
	1	2	3	4	5	6-10	11-17	18	
Costs :									
Plantation costs	1104	337	-	-	-	-	-	-	1441
Maintenance operations	656	107	74	193	262	791	233	-	2316
Miscellaneous and harvesting	136	93	38	49	53	218	-	537	1124
Total cost	1896	537	112	242	315	1009	233	537	4881
Benefits :									
Fuelwood	-	-	-	162	246	803	728	6780	8719
Fodder	-	-	-	212	291	1073	203	-	1779
Timber	-	-	-	-	-	-	-	27870	27870
Total benefits	-	-	-	374	537	1876	931	34650	38368
Discounted costs @ 12% pa	1896	480	90	173	201	457	54	78	3429
Discounted benefits @ 12% pa	-	-	-	299	384	849	214	5051	6779

NPW = Rs 6779 - Rs 3429 = Rs 3350

$$\text{B-C ratio} = \frac{\text{Rs } 6779}{\text{Rs } 3429} = 1.97$$

Note : 1. Plantation costs include costs of seedlings, site clearance, pit digging and filling etc.
2. Maintenance costs include costs of lopping, fencing and fence repairs etc.

With no benefits up to third year of plantation, the initial benefits came through the fuelwood (lopping material) which amounted to Rs. 11,050 in the last year of plantation when all the trees were harvested. Benefits worth Rs. 60,500 were generated out of timber value resulting in total un-discounted benefits of Rs. 83,773.

The NPW of *D. sissoo* plantation was calculated to be Rs. 5,611 with a B-C ratio of 2.59 indicating an attractive investment opportunity.

2. *Albizia lebbek* (Siris) : *A. lebbek* in study area, is planted for meeting fuelwood, fodder and timber (both for building as well as for agricultural implements) requirements.

The total discounted cost to raise the plantation of 100 trees of *A. lebbek* came out to Rs. 3,429 over 18 years with a major

Table 7

Year-wise detailed cost of plantation of Toona ciliata in eroded soils (Rs / 100 trees)

Particulars	Years									Total
	1	2	3	4	5	6-10	11-15	16-19	20	
Costs :										
Plantation costs	1202	318	-	-	-	-	-	-	-	1520
Maintenance operations	922	170	166	157	103	96	-	-	-	1614
Miscellaneous and harvesting	118	82	45	38	25	18	-	-	484	810
Total cost	2242	570	211	195	128	114	-	-	484	3944
Benefits :										
Fuelwood	-	-	-	-	-	-	-	-	6156	6156
Timber	-	-	-	-	-	-	-	-	66164	66164
Total benefits	-	-	-	-	-	-	-	-	72320	72320
Discounted costs @ 12% pa	2242	509	169	139	82	52	-	-	56	3249
Discounted benefits @ 12% pa	-	-	-	-	-	-	-	-	8397	8397

NPW = Rs 8397 - Rs 3249 = Rs 5148

$$\text{B-C ratio} = \frac{\text{Rs } 8397}{\text{Rs } 3249} = 2.58$$

Note : 1. Plantation costs include costs of seedlings, site clearance, pit digging and filling etc.
2. Maintenance costs include costs of fencing and fence repairs.

expenditure of Rs. 1,896 (55.29%) incurring in the first year. In 2nd year and from 6th to 10 year a discounted cost of Rs. 480 and Rs. 457 was incurred in various operations for maintenance of plantation. Operation-wise cost pattern was similar to that of *D. sissoo*.

Initial benefits came through fuelwood (lopping material) and fodder starting from 4th year with a minimum value of Rs. 374 while the maximum benefits of Rs. 34,650 were recorded in 18th year of plantation. The highest proportion on un-discounted benefits came out of timber wood of *A. lebbek* plantation which amounted to Rs. 27,870 at the time of harvesting. However, the total discounted benefits of the plantation came out to be Rs. 6,779.

The NPW was Rs. 3,350 for a lot of 100 trees with a B-C ratio of 1.97. Both NPW and B-C ratio indicated profitable plantation potential of *A. lebbek* in the study area and similar areas.

Table 8

Year-wise detailed cost of plantation of Grewia optiva in eroded soils (Rs / 100 trees)

Particulars	Years									Total
	1	2	3	4	5	6-10	11-20	21-24	25	
Costs :										
Plantation costs	1221	355	-	-	-	-	-	-	-	1576
Maintenance operations	871	178	123	476	986	4960	9392	3597	806	21389
Miscellaneous and harvesting	149	117	87	63	59	121	163	112	562	1433
Total cost	2241	650	210	539	1045	5081	9555	3709	1368	24398
Benefits :										
Fuelwood	-	-	-	83	406	2437	4253	1662	1234	10075
Fodder	-	-	-	569	2057	17258	24376	12126	8192	74578
Total benefits	-	-	-	652	2463	19695	38629	13788	9426	84653
Discounted costs @ 12% pa	2241	580	168	385	666	2299	1848	325	90	8602
Discounted benefits @ 12% pa	-	-	-	466	1569	8912	7472	1206	621	20246

$$\text{NPW} = \text{Rs } 20246 - \text{Rs } 8602 = \text{Rs } 11644$$

$$\text{B-C ratio} = \frac{\text{Rs } 20246}{\text{Rs } 8602} = 2.35$$

Note : 1. Plantation costs include costs of seedlings, site clearance, pit digging and filling etc.
2. Maintenance costs include costs of lopping, fencing and fence repairs etc.

3. *Toona ciliata* (Tuni) : *T. ciliata* species provides very fine quality timber and prefers to grow in moist and shady ravines (Ram Prakash, 1991).

The total establishment cost (discounted) for a lot of 100 trees came out to be Rs. 3,249 with major cost being incurred in the 1st year of plantation which amounted to Rs. 2,242. Since, browsing can result in heavy mortalities, adequate attention had to be paid on fencing and fence repairs which is reflected by regular expenses up to more than six years. There were no cost on pruning and other related operations while nominal cost was reported on miscellaneous operations.

Over the age of 20 years, only a benefit of Rs. 72,320 out of timber and fuelwood in the last year of plantation accrued. Fuelwood contributed Rs. 6,156 towards total benefits.

The NPW of *T. ciliata* plantation came out to Rs. 5,148 with a B-C ratio of 2.58. It

is an indicator of profitable investment potential for raising *T. ciliata* plantations.

4. *Grewia optiva* (Beul) : The inner bark of this species yields a fibre which is used for rope making. Branches are used for basket making and the fruits are edible. The wood is reported to be suitable for paper making (Ram Prakash, 1991). In the study area this tree is grown for its high quality fodder. However it also provides fuelwood and timber for agricultural implements.

The total discounted cost to raise the plantation of 100 trees of *G. optiva* came out to Rs. 8,602 over 25 years of plantation of which maximum expenditure of Rs. 2,299 was incurred in 6-10 years of plantation. This is mainly attributed to high intensity of lopping operations that continue up to the last year of maturity of plantations. A discounted cost of Rs. 2,241 was incurred in the first year on plantation costs, while, expenditure on lopping was major cost component for the remaining period of plantation.

No benefits accrued up to 3rd year of plantation. Fuelwood available from *G. optiwa* plantation was valued to be of Rs. 10,075 out of which the maximum contribution (Rs. 4,253) was during the period of 11th to 20th year of plantation. Fodder benefit worth Rs. 34,376 accrued during 11th to 20th year while only Rs. 569 were generated during the 4th year. It can be noted that total benefits of entire plantation from fuelwood and fodder together amounted to Rs. 84,653. However, discounted total benefits were equal to Rs. 20,246.

The NPW of *G. optiva* plantation was calculated to be Rs. 11,644 with a B-C ratio of 2.35. It suggests that these plantations are very profitable even in the eroded/degraded soils of foot hills in Shivalik range.

Conclusion

It can be observed that NPW of 100 trees plantation was highest (Rs. 11,644) for *G. optiva* and lowest (Rs. 3350) for *A. lebbek*. It was due to the fact that the *G. optiva* fodder is very palatable, nutritive and favourite of animals in the study area, and thus was valued highly. Moreover this tree species starts giving regular returns right from fourth year of plantation which increases discounted value of benefits.

The study shows that every rupee invested in the plantation of agro-forestry trees in eroded soils generates highest return of Rs. 2.59 (B-C ratio) in case of *D. sissoo* and lowest of 1.97 for *A. lebbek*. *G. optiva*, which had the highest NPW had a B-C ratio of only 2.35. The reason for high cost in case of *G. optiva* was heavy labour cost for lopping from 8th to 20th year of plantation. A similar trend may be observed for other fodder generating species i.e. *A. lebbek*. Such cost was either negligible or absent for other two species. The study also indicated that benefits in agro-forestry plantations are heavily discounted as compared to the corresponding costs due to the reason that benefits accrue in the later years while costs in the initial years. However, plantations of all the four agro-forestry tree species were found to be profitable.

Acknowledgements

This research paper is a modified version of the original paper presented at the 'International Symposium on Sustainable Hill Agriculture' from October 29-31, 1998 at HPKV, Palampur (H.P.).

SUMMARY

Establishment of successful agro-forestry plantations in fragile eco-systems such as eroded soils is a difficult job as it involves relatively higher cost and generates less returns. Site specific benefit-cost studies for plantations on such sites thus are important. The present study was undertaken in the Upper-Swan river catchment area of Una District in Himachal Pradesh. This catchment area is peculiar for its eroded soils. Tree species, *Dalbergia sissoo, Albizia lebbek; Toona ciliata* and *Grewia optiva* were considered for analysis. Plantations being sparse the calculations were done on per 100 tree basis at relatively higher (12%) rate of returns. Results indicated that the plantations under consideration were profitable as both, Net Present Worth (NPW) and the Benefit - Cost ratio (B-C ratio) criteria testify it. *Grewia optiva* being very popular and useful fodder species of the area, yielded the highest NPW (Rs. 11,644) followed by *Dalbergia sissoo* (Rs. 5,611), *Toona ciliata* (Rs. 5,155) and *Albizia lebbek* (Rs. 3,350). However, the B-C ratio was found to be the highest for *Dalbergia sissoo* (2.59) followed by *Toona ciliata* (2.58), *Grewia optiva* (2.35) and *Albizia lebbek* (1.97).

अपक्षरित मृदाओं के कृषि-वानिकी वृक्षों का लागत-लाभ विश्लेषण-ऊना जिले (हि॰प्र॰) के ऊपरी स्वान जलग्रह क्षेत्र का विशेष अध्ययन

राजेश के॰ राणा, पी॰ कौशल व वाई॰एस॰ नेगी

साराशं

अपक्षरित परिस्थिति-संहतियों जैसे अपक्षरित जमीनों में कृषिवानिकी रोपवनों को स्थापित कर पाना कठिन कार्य है क्योंकि इनमें लागत अपेक्षतया ज्यादा आती है और प्रत्याय (या लाभ) कम प्राप्त होती है। ऐसे स्थलों के लिए स्थल-विशिष्ट लागत-लाभ अध्ययन करना बहुत महत्वपूर्ण होता है। प्रस्तुत अध्ययन हिमाचल प्रदेश के ऊना जिले के ऊपरी स्वान नदी जलग्रहण क्षेत्र में कराया गया। इस जलग्रहण क्षेत्र की खास बात इसकी अपक्षरित मिट्टियां हैं। *डलबर्गिया सिस्सु, एल्बीजिया लेब्बेक, तुना सिलियाटा* और *ग्रीविया आप्टिवा* वृक्ष-जातियों को विश्लेषणार्थ लिया गया। रोपवन छितराए हुए रहने के कारण गणनाओं को प्रति 100 वृक्षों के आधार पर अपेक्षतया अधिक ऊंची प्रत्याय दर (12%) पर किया गया। परिणाम यह संकेत करते हैं कि विचारार्थ लिए गए रोपवन लाभकर हैं क्योंकि शुद्ध वर्तमान मूल्य और लागत-लाभ अनुपात दोनों कसौटियां इसे प्रमाणित करती हैं। *ग्रीविया आप्टिवा* इस क्षेत्र की लोकप्रिय चारा प्रदायक वृक्षजाति है और इससे सर्वाधिक शुद्ध वर्तमान लाभ (11,644 रु॰) मिला, इसके बाद क्रमवार *डलबर्गिया सिस्सु* (5,611 रु॰), फिर *तुना सिलियाटा* (5,155 रु॰) और *एल्बीजिया लेब्बेक* (3,350 रु॰) रहे। तथापि लागत-लाभ अनुपात सर्वाधिक *डलबर्गिया सिस्सु* का और (2.59 रु॰), उसके बाद *तुना सिलियाटा* (2.58), *ग्रीविया आप्टिवा* (2.35) और *एल्बीजिया लेब्बेक* (1.97) रहे।

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STUDIES ON SACRED GROVES AND TABOOS IN PURULIA DISTRICT OF WEST BENGAL

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Introduction

Sacred groves are the refuge of certain plant species preserved on religious grounds which can satisfy the aesthetic, scientific, cultural, and recreational needs of mankind. Eviction of certain plant species from hereditary homesteads forbidden by religious interdict are called Taboos. Several groves and taboos along with their climax of vegetation are found in secluded tribal areas mostly in hilly jungles in the district of Purulia in West Bengal. They show optimum growth of vegetation relevant to local topography.

Area of study

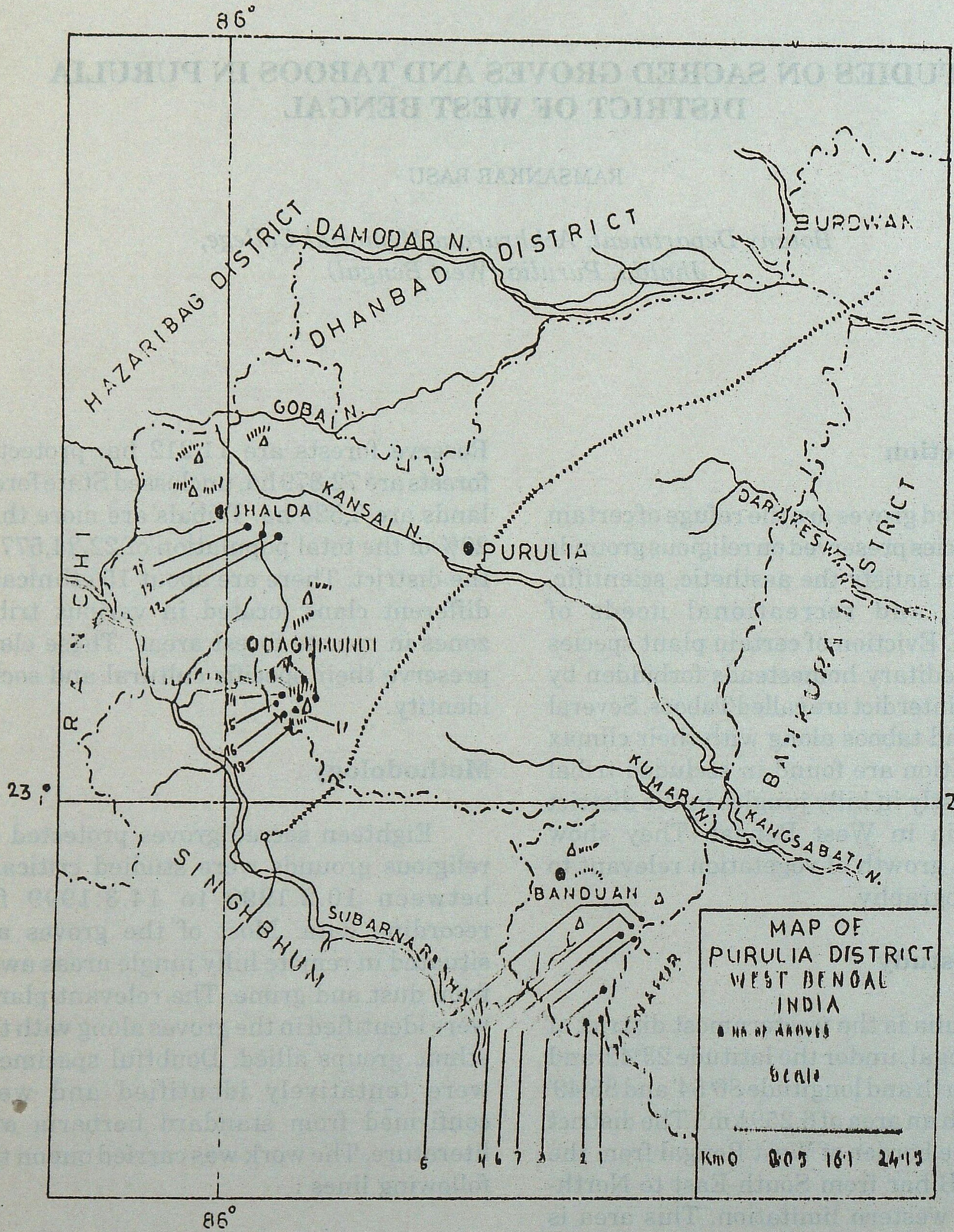
Purulia is the westernmost district of West Bengal, under the latitude 23°42' and 22°43' North and longitude 86°54' and 85°49' East, with an area of 6,259 km². The district marks the border of West Bengal from the State of Bihar from South-East to North-East via western limitation. This area is under Archaean gneiss of Chhotanagpur Plateau. The temperature falls up to 7°C in winter and attains up to 44°C in summer. Annual rainfall is 1701 mm. The place has deciduous type of monsoon vegetation. Reserve forests are 11,212 ha, protected forests are 72,879 ha, unclassed State forest lands are 3,523 ha. Tribals are more than 20% of the total population of 22,24,577 of the district. There are about 15 ethnically different clans located in various tribal zones in remote forest areas. These clans preserve their specific cultural and social identity.

Methodology

Eighteen sacred groves protected on religious grounds were studied critically between 10.2.1999 to 14.3.1999 for recording data. Most of the groves are situated in remote hilly jungle areas away from dust and grime. The relevant plants were identified in the groves along with the ethnic groups allied. Doubtful specimens were tentatively identified and were confirmed from standard herbaria and literature. The work was carried out on the following lines :

I. Sacred grove studied (Table 1)
II. Species habit (Table 2)
III. Species classified (Table 3)
IV. Individuality (Table 4)
V. Aboriginality (Table 5)

Fig. 1



Purulia, West District (West Bengal)

VI. Festivity (Tables 6a and 6b)
VII. Ascendancy (Table 7).

Special efforts were made to record folklores and beliefs relevant to sacred

groves. Notes made by early workers are no doubt informative but restricted to different localities (Gadgil and Vartak, 1975, 1981; Vartak and Gadgil, 1981; Vartak *et al.*, 1986; Hajra, 1990; Vartak, 1996).

Enumeration of other species

Trees

Aegle marmelos (Bel), *Albizia odoratissima* (Gobraman), *Anona squamosa*

Table 1

Sacred Groves studied

Total Groves	Total Areas	Aboriginal Trees Population	Aboriginal Tree Species	Total No. of species
18	72,681 m²	1936	55	106

Table 2

Species Habit

Trees	Shrubs	Herbs	Lianes	Climbers	Epiphytes	Parasites
55	20	21	05	03	01	01

Table 3

Species Classified

Dicot	Monocot	Total
100	06	106

Table 4

Individuality

Sl.No.	Sacred groves	Area (m²)	Altitude (m)	Aboriginal trees population
1	2	3	4	5
1.	Gurpana	2081	250	135
2.	Amgara	1106	200	87
3.	Harada	1325	200	150

Contd...

1	2	3	4	5
4.	Pukurkata	1806	250	41
5.	Khariathupa	133	250	22
6.	Paharpur	625	250	64
7.	Nutandih	803	205	131
8.	Lohadungri	1500	625	215
9.	Saparambera	3000	625	160
10.	Ranga	2500	625	135
11.	Chatamghutu	3975	350	60
12.	Gopalpur	7000	350	9
13.	Mohukodor	2650	350	25
14.	Ekra	1325	320	41
15.	Chiknobagan	1004	400	7
16.	Daurigara	35000	610	300
17.	Charka hill	3975	660	283
18.	Kuduma	5000	400	71

Table 5

Aboriginality

Sl. No.	Sacred Groves	Approximate age (yrs.)	Aboriginal plants	Height (m)	Circum-ference(m)
1.	Gurpana	240	*Shorea robusta* (Sal)	18.28	1.52
2.	Amgara	250	- do -	21.92	4.57
3.	Harada	357	- do -	20.72	2.59
4.	Pukurkata	200	- do -	21.94	2.43
5.	Khariathupa	10	*Albizia chinensis* (Chapati)	10.00	0.91
6.	Paharpur	200	*Shorea rubusta* (Sal)	27.43	4.87
7.	Nutandih	240	- do -	16.45	1.92
8.	Lohadungri	90	*Diospyros tomentosa* (Kend)	13.71	1.82
9.	Saparambera	250	*Shorea rubusta* (Sal)	16.82	1.76
10.	Ranga	300	- do -	30.48	3.65
11.	Chatamghutu	300	Bush of *Butea, Lantana, Alangium* (Palas, Putus, Dhela)	1.21	2.43
12.	Gopalpur	250	*Tamarindus indica* (Tentul)	14.63	4.87
13.	Mohukodor	250	*Casearia elliptica* (Churchu)	17.37	1.92
14.	Ekra	377	*Bombax ceiba* (Simal)	25.60	4.87
15.	Chiknobagan	190	*Ficus benghalensis* (Bat)	17.37	12.19
16.	Daurigara	358	*Adina cordifolia* (Karam)	33.22	4.87
17.	Charka hill	410	*Shorea robusta* (Sal)	16.76	1.82
18.	Kuduma	410	*Terminalia crenulata* (Asan)	16.45	1.82

Table 6a

Main Festivity

Sl. No.	Sacred grove	Main Deity	Main festival	Season	Ethnic group
1.	Gurpana	Maramburu	Sarul	March	Santhals
2.	Amgara	Jahirburu	- do -	- do -	Kurmis
3.	Harada	- do -	Ashari	July	Santhals, Mahalis
4.	Pukurkata	Garamburu	- do -	- do -	Santhals, Sabars
5.	Khariathupa	Muraburu	- do -	- do -	Bhumijs
6.	Paharpur	Baha	Sarul	March	Santhals
7.	Nutandih	Garamburu	Ashari	July	- do -
8.	Lohadungri	Sarul	Sarul	March	- do -
9.	Saparambera	Jaherburi	- do -	- do -	- do -
10.	Ranga	Garam Deota	- do -	- do -	- do -
11.	Chatamghutu	Ashari	Ashari	July	Bhumijs, Murmis,Mahalis
12.	Gopalpur	Jahirburi	- do -	- do -	- do -
13.	Mohukodor	- do -	- do -	- do -	- do -
14.	Ekra	Maghi	Maghi	January	Bhumijs
15.	Chiknobagan	Shiva	Sankranti	April	Kurmis
16.	Daurigara	Sindurpeti	Shrabani	August	Bhumijs, Kurmis, Loharas, Santhals
17.	Charka hill	Charkaburu	Maghi	January	Bhumijs
18.	Kuduma	Burababa	- do -	- do -	- do -

Table 6(b)

Festival requisite

Festival	Time	Groves Nos.	Offerable plants	Sacrificial animals
1	2	3	4	5
Sarul	Holi	1,2,4,5,6,7,8, 9,10,11	Flowers of *Shorea Madhuca*, seeds of *Trigonella foenum-graecum*	Male goat and sheep, female swine and calf fowl.
Maghi	5th or 6th March for forest entrance	1,5,7,9,11,12, 14,17	Flowering twigs of *Combretum roxburghii* *Shorea robusta*	Male goat and fowl

Contd...

1	2	3	4	5
Ashari	Rainy season before paddy plantation	1-7, 11-14	Leaves of *Shorea robusta*, Flowers of *Aegle marmelos*, *Phyllanthus emblica*	Male sheep and fowl, female goat & swine
Bandna	Kartik Purnima	1,4,5,7	Flowers of *Nymphaea stellata*, spikelets of *Oryza sativa*	N.A.
Chaitra Sankranti	14th April	15	Leaves and fruits of *Aegle marmelos*	Male goat
Sindur peti	Shraban purnima	16	Flowers of *Aegle marmelos*, *Phyllanthus emblica*	- do -
Burababa	- do -	18	- do -	- do -

Table 7

Ascendancy

Sl.No.	Sacred Grove	Prevalent species
1.	Gurpana	*Shorea robusta* (Sal), *Buchanania lanzan* (Pial)
2.	Amgara	*Shorea robusta, Terminalia crenulata* (Asan)
3.	Harada	*Shorea robusta, Diospyros tomentosa* (Kend)
4.	Pukurkata	*Shorea robusta, Diospyros tomentosa*
5.	Khariathupa	*Albizia chinensis* (Chapati), *Casearia gräveolens* (Chilla)
6.	Paharpur	*Shorea robusta, Terminalia crenulata*
7.	Nutandih	*Shorea robusta, Anogeissus latifolia* (Dhaw)
8.	Lohadungri	*Terminalia crenulata, Anogeissus latifolia*
9.	Saparambera	*Shorea robusta, Terminalia crenulata*
10.	Ranga	*Anogeissus latifolia, Terminalia crenulata*
11.	Chatamghutu	*Butea monosperma* (Palas), *Alangium salvifolium* (Dhela)
12.	Gopalpur	*Tamarindus indica* (Tentul), *Mitragyna parvifolia* (Gurikaram)
13.	Mohukodor	*Casearia elliptica* (Churchu), *Diospyros montana* (Lohajangi)
14.	Ekra	*Diospyros montana, Bombax ceiba* (Simal)
15.	Chiknobagan	*Ficus benghalensis* (Bat), *Syzygium cumini* (Jam)
16.	Daurigora	*Terminalia crenulata, Shorea robusta*
17.	Charka hill	*Diospyros malabarica* (Kana-kend), *Shorea robusta*
18.	Kuduma	*Terminalia crenulata, Anogeissus latifolia*

(Madar), *Artocarpus lacucha* (Dahu), *Azadirachta indica* (Neem), *Bridelia crenulata* (Kasoi), *Cassia fistula* (Sonal), *Catunaregam spinosa* (Loto), *Croton roxburghii* (Putla), *Dalbergia lanceolaria* (Lipsi), *Dalbergia sissoo* (Sissoo), *Ficus semicordata* (Ashar), *Ficus virens* (Pakur), *Gardenia latifolia* (Bhutru), *Grewia damine* (Bursakhera), *Grewia subinaequalis* (Dhemon), *Adina cordifolia* (Karam), *Holarrhena pubescens* (Kurchi), *Lagerstroemia parviflora* (Sidha), *Lannea coromandelica* (Doka), *Madhuca indica* (Mohul), *Mallotus philippensis* (Rora), *Olax scandens* (Hund), *Oroxylum indicum* (Bhalsupti), *Phoenix sylvestris* (Khejur), *Polyalthia cerasoides* (Panjon), *Protium serratum* (Kanrior), *Pterocarpus marsupium* (Murga), *Schleichera oleosa* (Kusum), *Semecarpus anacardium* (Bhela), *Soymida febrifuga* (Rohin), *Streblus asper* (Saora), *Tectona grandis* (Segun), *Terminalia bellerica* (Bahera), *Terminalia chebula* (Haritaki), *Terminalia tomentosa* (Asta), *Vitex negundo* (Lily-sinduar), *Vitex peduncularis* (Bhaduri).

Shrubs

Calotropis procera (Akand), *Capparis zeylanica* (Asharilat), *Carissa opaca* (Bainchi), *Cassia occidentales* (Kalkasunda), *Cassia sophera* (Jhunjhuni), *Cassia glauca* (Meroi), *Cleistanthus collinus* (Parasi), *Clerodendrun viscosum* (Ghetu), *Cryptolepis buchanani* (Chhagaldudhi), *Erycibe paniculata* (Kari), *Flueggea obovata* (Petari), *Hemidesmus indicus* (Anantamul), *Jatropha curcas* (Bherenda), *Lantana camara* (Putus), *Leonurus sibiricus* (Raktadron), *Milletia extensa* (Agyai), *Morinda pubescens* (Chailikadam), *Opuntia stricta* var. *dillenii* (Phanimansa), *Wendlandia tinctoria* (Tilai), *Ziziphus mauritiana* (Kul).

Herbs

Achyranthes aspera (Swet-Apang), *Achyranthes aspera* var. *porphyristachya* (Lal-apang), *Agave cantula* (Konga), *Andrographis paniculata* (Kalmegh), *Boerhavia diffusa* (Punarnava), *Cassia tora* (Chakoara), *Chrysopogon aciculatus* (Chorkanta), *Commelina benghalensis* (Kanshira), *Costus speciosus* (Kneua-kanda), *Elephantopus scaber* (Majurjhunti), *Erythrina suberosa* (Chaldua), *Euphorbia hirta* (Chhotodudhi), *Grangea maderaspatana* (Bhediachim), *Hygrophila auriculata* (Kulekhara), *Ochna obtusata* var. *pumila* (Bhuikusum), *Ocimum gratissimum* (Kalatulsi), *Ocimum tenuiflorum* (Tulsa), *Polygala arvensis* (Rali), *Rungia pectinata* (Hesa-arak), *Sida cordata* (Berala), *Tridax procumbens* (Tridaksha).

Lianes

Bauhinia vahlii (Chihor), *Butea superba* (Lat-palas), *Celastrus paniculata* (Kujri), *Dioscorea bulbifera* (Baola), *Ventilago denticulata* (Bonga-sarjom).

Climbers

Ichnocarpus frutescens (Shyamlata), *Trichosanthes tricuspidata* (Kanbutki), *Vitex latifolia* (Paniloha).

Epiphytes

Vanda testacea (Dare-banki).

Parasites

Loranthus longiflorus (Bandalata)

Taboos

Removal of any plant material from

the grove is taboo. These taboos scrupulously preserved their traditional customs and enjoin to behave with nature. Some of these reliances relevant to sacred groves are as follows :

(i) Plants felled by lightening or unforeseen fatal calamities will be used only for religious purpose. (Amgara, Grove 2)

(ii) The Bengalees can not be settled nearby groves; can not be alive; even forest animals take them as prey. (Harada, Grove 3)

(iii) In 1960, the villagers solemnly offered earthen elephants and horses to the deity of sacred groves to restrain smallpox. (Pukurkata, Grove 4)

(iv) In 1979, Atul Karmakar, a petti-fogging person cut the old plants of *Shorea robusta* from the grove. They were compelled to leave the village within the year due to attack by serpents, and contagious diseases. (Khariathupa, Grove 5)

(v) In 1989, a priest (Laya) cut up an old *Shorea robusta* tree from the grove. During felling one cat came and mewed. His first son died untimely. (Ranga, Grove 10)

(vi) In 1995, wood of *Diospyros montana* was cut from the grove by Bhagirath Paramanik of Baruadih. He went mad. (Chatamghutu, Grove 11)

(vii) In 1975, Gopal Karmakar, a contractor couped *Shorea robusta* trees from the grove. Thence, his son went mad. (Chakra Hill, Grove 17).

The villagers respect this religious interdict even today. Such taboos preserved the sacred groves in virgin condition.

Conservation

The taboos are beginning to weaken. Some older plants have succumbed to termites and some struck down by lightening. Need for conservation is both from practical and aesthetic point of view. Forest Department can take up these groves under plan of Biodiversity conservation. Groves within private lands need sustainable protection. Local communities can resist the felling of trees whether it be from natural calamities, pathogenic infection, or human interference. Maintaining their sanctity, these groves can be utilized for nursery of medicinal herbs, true-breeding wild species, and species of economic potential. These groves are also refuge for arboreal birds and mammals, and other forest animals. Efforts should be make to protect these groves by preserving the status quo.

Economic significance

1. Sacred groves show diversity of species within the environment.
2. Climbers, epiphytes, even parasites depend upon lofty trees for lifehold.
3. Sacred groves become the last refuge of many plant species.
4. It produces listless litter on the ground.
5. Local inhabitants collect medicinal herbs from the groves retaining their sanctity.
6. Sacred groves ensconce as genetic variorum in specific endemic areas.
7. They give a prognostic feature of sylvan programme over particular geographical region.

Conclusion

Until the Forest and Wildlife Department takes up conservation of sacred groves, constitutes them into a network of nature preserves, takes necessary steps for their planning and co-ordination, and alongside unless the villagers themselves keep faith in their tradition of religious beliefs and taboos and their solemn obligation on sacred groves, exploitation and degradation of these pockets of climax vegetation in this hilly area can not be stopped.

Acknowledgements

The author is thankful to the Forest Department Staff of Purulia for providing facilities in field work. Thanks are due to UGC for providing financial assistance. Thanks are also due to S.L. Majhi (Principal), R.N. Halwai, A.C. Mahato, A.K. Singha Deo and P. Lata of this college for their willing help in the preparation of this work.

SUMMARY

Small pockets of forest maintained in a sound state on cultural and religious beliefs, serving as the pristine refuge of plants are known as Sacred groves. Taboos (religious interdictions), protect the plants and even arboreal birds, mammals, and other forest dwelling animals in any sacred grove from eviction. Purulia District in West Bengal with an area of 6,259 km² has a large number of sacred groves and ethnic races. 18 sacred groves were studied there between February-March 1999. These groves are spread over 72,681 m² area and contain 106 species variform, of which, aboriginal tree species are 55, and their total population is 1936. Ethnic groups met with are Bhumijs, Kurmis, Loharas, Mahalis, Sabars and Santhals. They offer goat, sheep, swine, calf, fowl to their deity sacramentally in the groves on religious occasions. Efforts should be made to protect this type of vegetation that existed long before human interference.

पश्चिम बंगाल के पुरूलिया जिले के पावन निकुंजों और वर्जनाओं का अध्ययन

रमाशंकर बसु

सारांश

वन का एक छोटा सा टुकड़ा जो किसी सम्प्रदाय के लिए अच्छी हालत में सुरक्षित रखा गया हो और भविष्य-कथन पादपों का अन्तिम शरण्य हो पावन निकुंज कहा जाता है । वर्जनाएं ऐसी धार्मिक निषेधाज्ञाएं होती हैं जिनका संपोषण परेशान करने वाले प्रश्नों से किया जाता है, जो पादपों के यहां तक कि वृक्षों के पक्षियों, स्तनियों और वनप्रिय जानवरों की भी वहां से निकाले जाने के प्रति रक्षा करती हैं । पश्चिम बंगाल का पुरूलिया जिला 6259 किमी² क्षेत्र का है । इस जिले में बहुत सारे पावन निकुंज और जातियां निवास करती हैं । 1999 के फरवरी-मार्च महीनों में 18 निकुंजों का अध्ययन किया गया । ये निकुंज 72,681 मी² में फैले हैं तथा इनमें तरह-तरह की 106 जातियां मिलती हैं । इनमें से 55 आदिम वृक्ष जातियां हैं । बसने वाली जनजातियों में भूमिजा, कुर्मी, लोहार, महाली, शबर और सन्थाल हैं । ये अपने निकुंजों में धार्मिक अवसरों पर अनुष्ठानपूर्वक अपने देवताओं को बकरा, भेड़ बछड़ा, मुर्गी की बलि चढ़ाते हैं । इस तरह की वनस्पतियों को सुरक्षित बनाए रखना चाहिए जो मानव हस्तक्षेप किया जाने से पूर्व बहुत अधिक समय से यहां रहती चली आ रही है ।

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RECORD OF LYMANTRIID SPECIES DEFOLIATING *PAULOWNIA FORTUNEI* IN INDIA

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Introduction

Paulownia fortunei, a native to China is one of the exotics currently tried in our country for agroforestry and afforestation programmes, in view of its fast growth and multiple utilities (Kumar and Ahmad, 1998). Ever since its introduction, insect infestation was detected and reported by some workers including Verma *et al*. (1997) and Kumar and Ahmad (1998 and 2000). Although *Paulownia* was seen getting infested by different groups of insect species but in this paper nature of damage, extent of infestation and population trend of insect pests belonging to family Lymantriidae are presented.

Material and Methods

Regular weekly survey for insect infestation in *Paulownia* nursery and plantation at New Forest, Dehra Dun were conducted as per randomised systematic design for two years, 1997 and 1998. Sampling was started from March onwards as the cuttings of *Paulownia* were planted in nursery during February. Sampled trees were thoroughly observed for insect infestation and all the insects found feeding on foliage of the plant were collected. Observations were recorded on feeding symptoms by different pest species as well as nature of damage caused to the host plants. Larvae collected during samplings were reared in the laboratory by keeping in the glass chimney cages provided with *Paulownia* foliage and covered over with muslin cloth. Leaves were changed after every 24 hours. Pupae were kept into separate cages and adult emergence was recorded. Moths got identified by comparing with the specimen of main insect reference collection, Forest Research Institute, Dehra Dun. Infestation level was arbitrarily rated as low, if population density was upto five insect/larvae per plant; moderate, if the density was between five and ten individuals per plant; and high, if the density exceeded ten insects per plant as described by Clark *et al*. (1966). Simple correlation (r) values of dependent (insect population) and independent variables (element of weather) were also calculated and their significance was tested by applying 't' test.

Results

Systematic survey to the nursery and plantation of *Paulownia* revealed defoliation by the six species of larvae belonging to family Lymantriidae along with other group of insects. Lymantriid

species were identified as *Orgyia postica* Walker, *Calliteara grotei* Moore, *Euproctis virguncula* Walker, *Euproctis fraterna* Moore, *Euproctis* sp. and *Dasychira* sp. All the six species were indigenous in nature and recorded for the first time infesting the foliage of *Paulownia* in India. They were found to be polyphagous and established pests of different native plant species. Among 6 lymantriid species, *Orgyia postica* and *Dasychira* sp. have shown high and moderate level of infestation on *Paulownia* foliage respectively, while remaining species were occasional visitors causing low infestation (Table 1).

Orgyia postica Walker is a polyphagous pest, known to cause infestation to many forestry, vegetable and agriculture crops including *Albizia lebbek, Anogeissus latifolia, Eucalyptus leucoxylon, Hevea brasiliensis, Santalum album, Shorea robusta, Tectona grandis, Terminalia bellirica* and *Xylia xylocarpa* (Beeson, 1941; Browne, 1968). Caterpillars of *O. postica* started appearing from March onwards with the establishment of *Paulownia* cuttings in the nursery and caused extensive damage to the plants from March to October (Fig. 2). *Orgyia postica* was found to be one of the potential pests of *Paulownia* capable to cause substantial damage to the plantation. Attack of remaining lymantriid species appeared much later (Fig. 2). Average number of the larvae of *O. postica* was over 0.75 per plant since its appearance and increased in subsequent months. Infestation by *O. postica* on *Paulownia* was more pronounced in comparison to other lymantriids. Peak period of its activity was July-September as average number of caterpillars was observed over 3.00 larvae per plant but maximum average number was observed upto 8.75 larvae per plant in August. Average population of *O. postica* constitutes over 66.74 per cent of all lymantriid species found on *Paulownia* (Fig. 1).

First instar larvae of *O. postica* feed in groups on soft tissues of epidermis on both the surfaces of the leaves. They were also seen feeding for some time on the empty egg shells just after hatching. Second instar larvae disperse and feed on all parts of the leaf. Larvae of second instar onwards were voracious feeders. During peak period of their activity, many *Paulownia* plants were seen completely defoliated. Female moth deposits eggs on the empty pupal cases attached to the plant. Egg laying on the pupal cases has also been observed in the laboratory breeding cages. *Orgyia postica* was found to be a potential pest of *Paulownia* posing serious problem to the plantation.

Larvae of *Calliteara grotei* Moore (Lepidoptera: Lymantriidae) was observed defoliating plants of *Paulownia* in the nursery as well as in plantation during July-October although its population was nil during September. Maximum population of *C. grotei* was recorded during July when average number of larvae was observed up to 1.75 per plant. During active period, caterpillars were found feeding on the young leaves. Its average population was 10.70 per cent of the total lymantriid species found on *Paulownia. C. grotei* was considered as a minor pest of *Paulownia* because of low infestation level and short period of infestation.

Euproctis virguncula was also a minor pest of *Paulownia* as its low level infestation was observed during October-November. Maximum population of *E. virguncula* was recorded upto 1.25 larvae per plant during November. Its population constituted 4.59

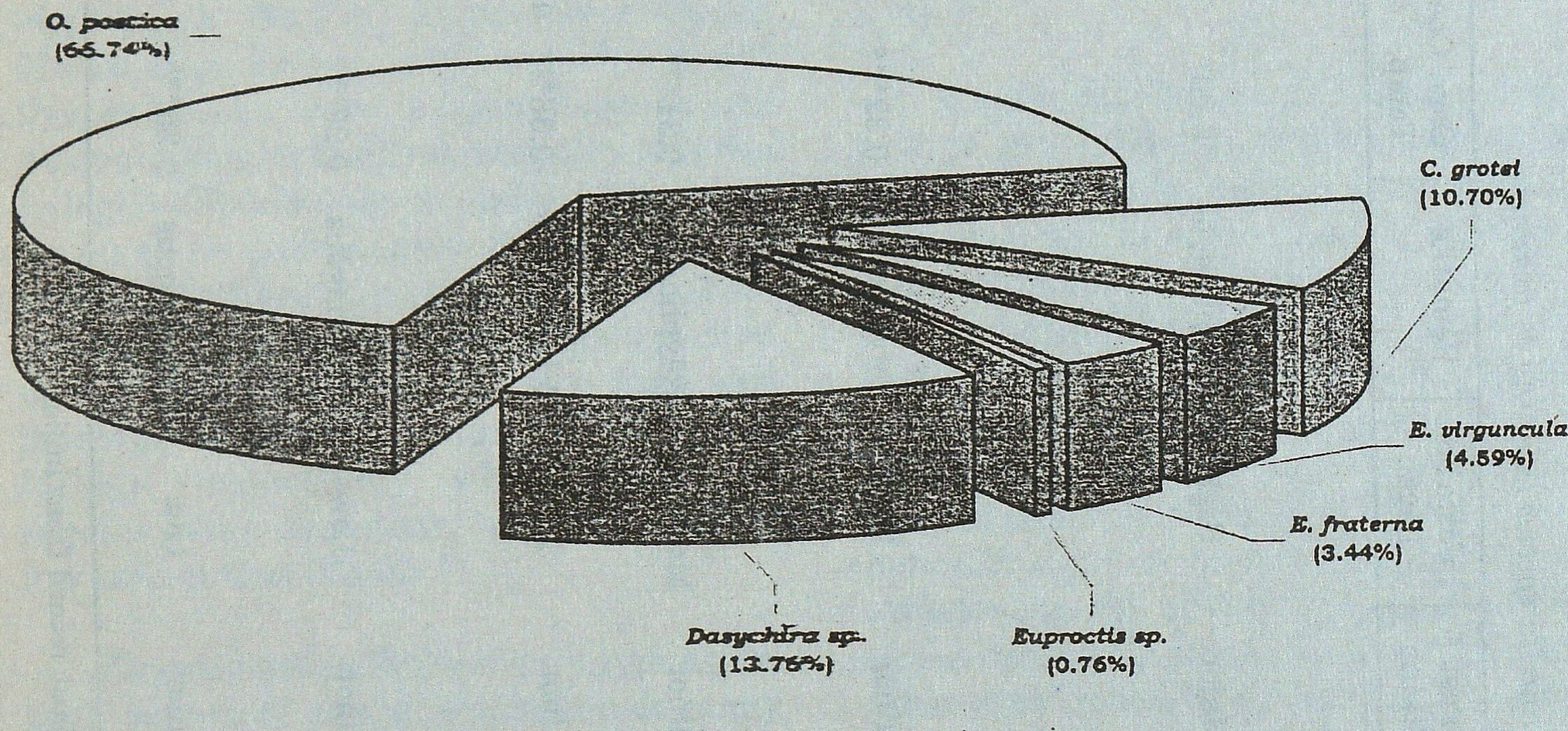
Table 1

Pest status, infestation level and correlation coefficient of lymantriid species infesting P. fortunei

Species***	Order : Family	Host Plants*****	Pest Status	Infestation Level	Remarks	Corr. Coeff. Temp.	Humi.
Orgyia postica Walker	Lepidoptera : Lymantriidae	*Albizia lebbek, Anogeissus latifolia, Eucalyptus leucoxylon, Hevea brasiliensis, Lagerstroemia indica, Mangifera indica, Ochroma lagopus, Pterocarpus marsupium, Santalum album, Shorea robusta, Tectona grandis, Terminalia bellerica, Xylia xylocarpa, Zizyphus mauritiana.*	Major	High	Polyphagous	0.50*	0.68**
Calliteara grotei Moore	Lepidoptera : Lymantriidae	*Acacia dealbata, A. nilotica, Lagerstroemia speciosa, Quercus inacana, Q. serrata, Schleichera oleosa, Shorea robusta, Tectona grandis*	Minor	Low	Polyphagous	0.32***	0.57**
Dasychira sp.	Lepidoptera : Lymantriidae	*Acacia* spp., *Lagerstroemia speciosa Quercus incana, Shorea robusta Tectona grandis, Terminalia myriocarpa*	Minor	Moderate	Polyphagous	0.31***	0.57**
Euproctis virguncula Walker	Lepidoptera : Lymantriidae	Foliage of dicotyledons and grasses *Dalbergia sissoo.*	Minor	Low	Polyphagous	-0.36***	0.04***
Euproctis fraterna Moore	Lepidoptera : Lymantriidae	*Aleurites fordii, Mangifera indica Ougeinia dalbergioides, Shorea robusta, Tectona grandis Terminalia myriocarpa, Trewia nudiflora, Zizyphus mauritiana Dalbergia sissoo, Shorea robusta,*	Minor	Low	Polyphagous	0.26***	0.53*
Euproctis sp.	Lepidoptera : Lymantriidae	*Tectona grandis*, Grasses	Minor	Low	Polyphagous	0.25***	0.44*

* = Significant at 5%, ** = Significant at 1%, *** = Non -significant and **** = New host record from India,
***** = After Beeson, 1941 and Browne, 1968.

Fig. 1



Per cent population composition of lymantriid species on *P. fortunei*

per cent of lymantriid population. Similarly, *Euproctis fraterna* was considered a minor pest as its infestation phase was from July to November with irregular appearance on *Paulownia* foliage (Fig. 2). Its population constituted 3.44 per cent of total population of lymantriid species found on *Paulownia* (Fig. 1).

Infestation of another species of *Euproctis* (unidentified) was observed from July to August during 1998. Population was as low as 0.25 larvae per plant. Infestation of yet another lymantriid, *Dasychira* sp. was observed from July to October with maximum population 3.00 larvae per plant during August in both the years 1997 and 1998. *Dasychira* sp. caused low to moderate level of infestation and constituted 13.76 per cent of total lymantriid population. Both *Euproctis* sp. and *Daychira* sp. were considered as minor pests of *Paulownia*.

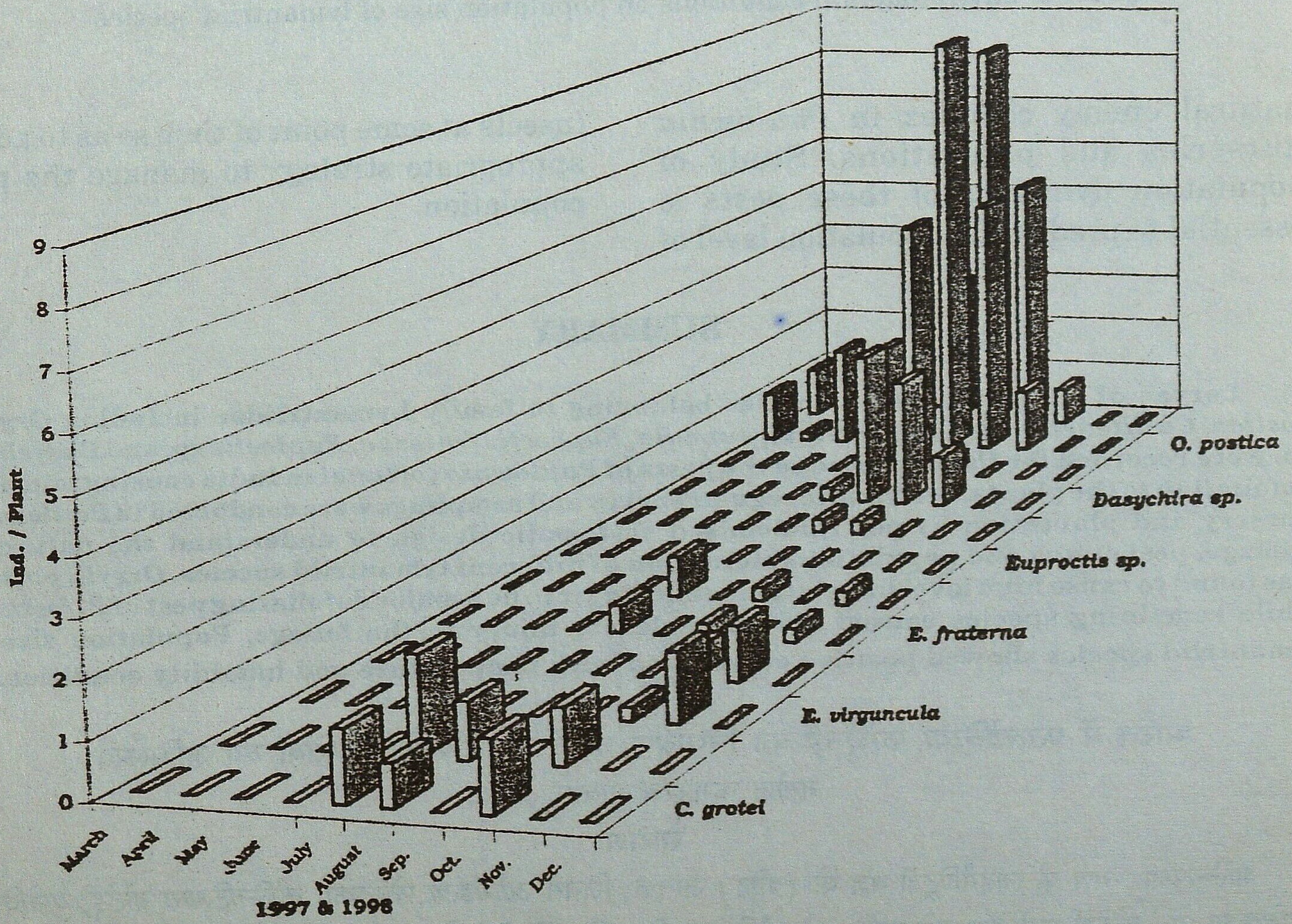
Environmental factors *viz.* temperature and humidity seem to play important role in regulating the population of lymantriid species in *Paulownia* nursery and plantation. All lymantriid species except *Euproctis virguncula*, indicated positive correlation with temperature and humidity. Population of lymantriid species was increased with the rise in temperature, though it was found significant (r = 0.50) only at 5% level in the case of *Orgyia postica* (Table 1). Population size of lymantriid species was increased from 1.00 individual/plant during March (when temperature was below 18°C with over 20 per cent humidity) to 12.50 larvae/plant in the month of August (When mean temperature was 24°C with relative humidity 85 per cent or above.) However, relatively high population of lymantriid species was observed from June to September in both the years (1997 and 1998) when temperature and humidity was

always above 23°C and 84 per cent respectively (Fig. 3).

Discussion

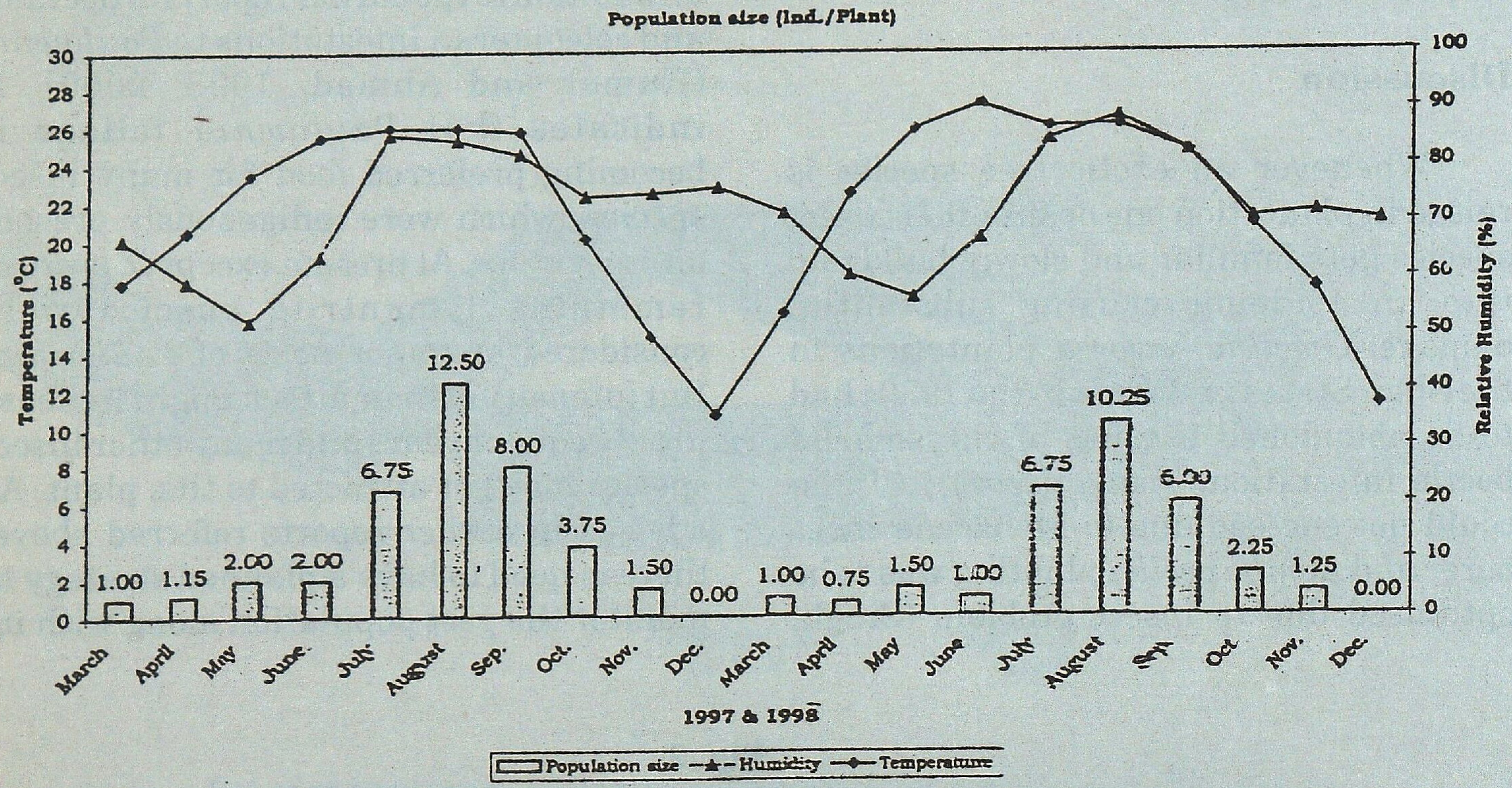
Whenever an exotic tree species is raised in plantation one or the other insect species gets familiar and slowly builds up into an epidemic causing substantial damage. *Gmelina arborea* plantations in the Shan States in Burma in the 1930s had to be abandoned because of chrysomelid beetle infestation. *Toona ciliata* in India could not succeed due to Meliaceae shoot borer and *Bombax ceiba* planting was to be optimised due to insect problem (Singh, 1990). Report of lymantriid infestation is an addition to the earlier reports of noctuids and coleopteran infestations to *Paulownia* (Kumar and Ahmad, 1998, 2000). It indicates that *Paulownia* foliage is becoming preferred food for many insect species, which were indigenously present on other crops. At present except *O. postica*, remaining lymantriid species were considered as minor pests of *Paulownia*. But intensity of their attack might increase in subsequent years and many other insect species may get attracted to this plant. As advised in earlier reports referred above, there is need to have a planned strategy to monitor the pest population along with its

Fig. 2



Population trends of lymantriids infesting *P. fortunei*

Fig. 3



Effect of environmental conditions on population size of lymantriid species

natural enemy complex in *Paulownia* nurseries and plantations. Study of population dynamics of these pests is essential to predict the population level of insects at some point of time so as to adopt appropriate strategy to manage the pest population.

SUMMARY

Larvae of six lepidopteran species belonging to family Lymantriidae including *Orgyia postica, Calliteara grotei, Euproctis virguncula, Euproctis fraterna, Euptoctis* sp. and *Dasychira* sp. were recorded for the first time as the pests of *Paulownia fortunei* in India causing multiple defoliation to the plants. Systematic regular survey and samplings were conducted in *Paulownia* nursery and plantation as per randomised systematic design to understand the nature of damage, pest status and population fluctuation of different lymantriid species. *Orgyia postica* was found to cause high level infestation rendering it to be a major defoliating pest of *P. fortunei* while remaining species caused low to moderate injury to the foliage. Population size of lymantriid species showed positive correlation with temperature and humidity conditions.

भारत में *पउलोव्निया फोर्चुनेई* का निष्पत्रण करते लाइमैण्ट्रिडी जातियों का अभिलेख

मनोज कुमार व मुख्तार अहमद

सारांश

शल्किपक्षा : गण के लाइमैण्ट्रिडी वंश के (कीट) जातक, जिनमें *औरगिंइआ पोस्टिका, कैल्लिटिआरा ग्रोटेई, युप्रोक्टिस विर्गुनकुला, यु० फैटर्नी युप्रोक्टिस* की जाति, और *डैसिशिरा* की जाति सम्मिलित हैं, पहली बार *पाउलोव्निया फोर्चुनेई* के पादपों का भारी निष्पत्रण करती, नाशिकीट के रूप में अभिलिखित की गई । हानि की प्रकृति नाशिकीट की स्थिति और लायमैण्ट्रिडी

वंश की विभिन्न जातियों की संख्या में घटाबढ़ी को समझने के लिए *पाउलोन्िया फोर्चुनेई* की रोपणी और उसके रोपवन में विधिवत समसंभाविक आकल्प बनाकर नियमित सर्वेक्षण किए और न्यादर्श निकाले गए । *आर्गिइआ पोजिटिका* को अधिक संख्या में पर्याक्रमण करते पाया गया जो इसे *पाउलोन्िया फोर्चुनेई* का प्रधान निष्पत्रक नाशिकीट बना देता है जबकि बाकी की अन्य जातियाँ इसकी पत्तियों को मामूली से मध्यम क्षति ही पहुंचाती हैं । लायमैण्ट्रिडी वंश की जातियों के संख्या आकार में तापमान और आर्द्रता दशाओं के साथ सकारात्मक सहसम्बन्ध रहता पाया गया ।

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STUDIES ON THE MORTALITY OF *CEDRUS DEODARA* (ROXB.) L. DON. IN CHAIL FOREST (H.P.) AND ITS CAUSATIVE FACTORS

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Introduction

Deodar [*Cedrus deodara* (Roxb.) L.Don] a gregarious conifer tree widely distributed throughout Western Himalayas particularly in Himachal Pradesh, India. It occurs abundantly in the districts Chamba, Dalhousie, Mandi, Nahan, Kulu, Chopal, Solan, Kinnaur and Shimla of Himachal Pradesh. The total area of the Deodar forests in Himachal Pradesh is estimated at 69,872 ha (Tewari, 1994). Reports were received about the dying of Deodar in Chail-Banjhani forest area during the year 1998 (Anon., 1998). Later Goraya *et al.* (1998) in a technical report stated that the mortality of Deodar in the forest was caused by root rot disease. The causative organism of the disease was identified as *Phytophthora cinnamomi* Rands, a highly destructive fungal pathogen. Even though the incidence of this pathogen has been reported from the Western Himalayan region for the first time, ample literature is available on this disease and the pathogen from many other countries from across the world. The pathogen, *P. cinnamomi*, has been reported to cause severe damage in tree species including, *Quercus rubra, Castamea sativa* (Robin and Loustau, 1998) *Persea americana* (Cacciola *et al.*, 1998), *Alnus glutinosa* (Brasier *et al.*, 1995) and *Eucalyptus marginata* (Shearer *et al.*, 1987; 1988). This pathogen is recorded as widely distributed fungal pathogen all over the world. In as far as Chail-Banjhani forest is concerned, a preliminary study has been taken with the following objectives :

1. To study the growth characteristics of fungal pathogen causing disease and its mode of infection.

2. Effect of physico-chemical properties of soil of *C. deodara* in diseased area and

3. Assess the frequency and distribution of *P. cinnamomi* over a period of time.

Material and Methods

The study site was selected in the Chail-Banjhani forest, 44 km away from Shimla and located at 77°15' E and 31°28' N at an elevation of 1676 m above msl. The total area of the affected forest is about 26 hectares. The study area was fenced by the State Forest Department with a view to isolate the site and to minimise the chances of further spread of disease through cattle movement. All the trees in the fenced plots

have been enumerated and recorded. These plots are being periodically monitored since December 1998 to know more about the pattern and spread of the disease. Special emphasis during the study was given to the diseased roots and the soils.

For systematic and detailed studies, the site was divided into the following three plots based on the occurrence of completely dead, diseased or healthy trees :

Plot A : all trees in the plot dead
Plot B : comprising of a mixture of totally dead, diseased and healthy trees
Plot C : comprising of all healthy trees except two diseased ones.

Protocol-A : The soil samples were collected from around five randomly selected trees in each plot and the composite soil samples were analyzed as to soil moisture as per method suggested by Jackson (1973) :

$$\text{Soil Moisture (\%)} = \frac{F.W - D.W}{F.W} \times 100$$

A constant fresh weighed soil sample (F.W) was kept in the Hot air oven at 120°C for 72 hours, the dry weight (D.W) was measured and the soil moisture was calculated according to the above formula.

Protocol-B : The nutrient analysis of the soil samples has been carried out by the method of Jackson (1973). The nutrients such as N, P, K were analyzed at Himachal Pradesh Agriculture Department, Shimla.

Protocol-C : The root infection has been observed by the method of Phillips and Hayman (1970) and the per cent of infection was calculated by the following formula :

$$= \frac{\text{Total Number of roots - Infected number of roots}}{\text{Total number of roots}} \times 100$$

Protocol-D : Assessment of further spread of disease and the average mortality of *C. deodara* was assessed on the following parameters :

Dead Trees : No green needles/dry branches intact/dry branches fallen off/bark fallen off/rotted.

Affected/Diseased Trees : Chlorotic/Needles fall off on shaking/short needles density of needles very thin/drying from the top.

Unaffected/Healthy Trees : Normal green/ dense tufts of needles/absence of dry branches.

Protocol-E : The diseased roots and soil samples were inoculated in the sterilized Potato Dextrose Agar medium (potato extract 200g, Agar 20 g, Dextrose 20g and Distilled water 1000 ml) in five replicated and stored at room temperature for observing the growth characteristics of the pathogenic fungi. The fungal identifications were made with the help of standard identification manuals (Domsch *et al.*, 1980; Tainter and Baker, 1996).

Frequency distribution of fungal species : The cultures developed in the laboratory were segregated and each fungus was monitored and frequency distribution of each fungus studied. Frequency denotes the number of samples in which a particular fungus was recorded during the period of study and is expressed in percentage of the total number of samples.

Table 1

Physico-chemical properties of the soil samples (mean of 5 replicates)

Plot No.	Soil moisture (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	pH
A	81 a	66 a	83 a	141 a	7.2 a
B	79.2 a	78 b	91 b	138 a	7.3 a
C	40.8 b	81 b	101 b	166 b	5.6 b

Means followed by a common letter are not significantly different at 5% level by DMRT.

$$\text{Frequency} = \frac{\text{Number of samples in which a particular fungus recorded}}{\text{Total Number of samples taken}} \times 100$$

On the basis of frequencies three categories were recognized as follows.

1-40% occasional; 41-80% common; and 81-100% abundant. The distribution of fungi in the samples at each sampling time was expressed in terms of percentage occurrence.

$$\text{Percentage Occurrence} = \frac{\text{Total number of individual fungal species in all samples}}{\text{Total number of fungi in all samples}} \times 100$$

Results

The physico-chemical properties of the soil samples showed that the pH of the soil is moderately alkaline in the diseased plots and acidic in the control plot. The status of nutrients in the control plot was higher than the diseased plots (Table 1). The intensity of root infection showed the diseased plots had higher infection and all healthy trees in control plot showed no infection (Table 2). The assessment of the damaged trees in three plots showed that in the mixed plot (Plot B) eight trees are dying and in the control plot (Plot C) the two already diseased trees had died. In plot 'A' thirty-eight trees were totally dead and only two trees are living (Fig. 1). The most dominant fungus identified from the analysis of root samples matched with description of *P. cinnamomi*. This fungus emerged in the pure culture within 15-17 days at room temperature (19-24°C) and showed the characteristics of (i) coenocytic mycelium, (ii) corolloid hyphae, hyphal swellings, and (iii) lemon shaped zoosporangium. Further, the frequency

Table 2

Assessments of pathogenic infection in diseased roots of Cedrus deodara (mean of 5 replicates)

Plot No.	Rate of infection (%)	SE
A	100	(±5.6)
B	84	(±7.8)
C	0	(±0.0)

A : Dead trees, B : Dying and dead trees, C : Control

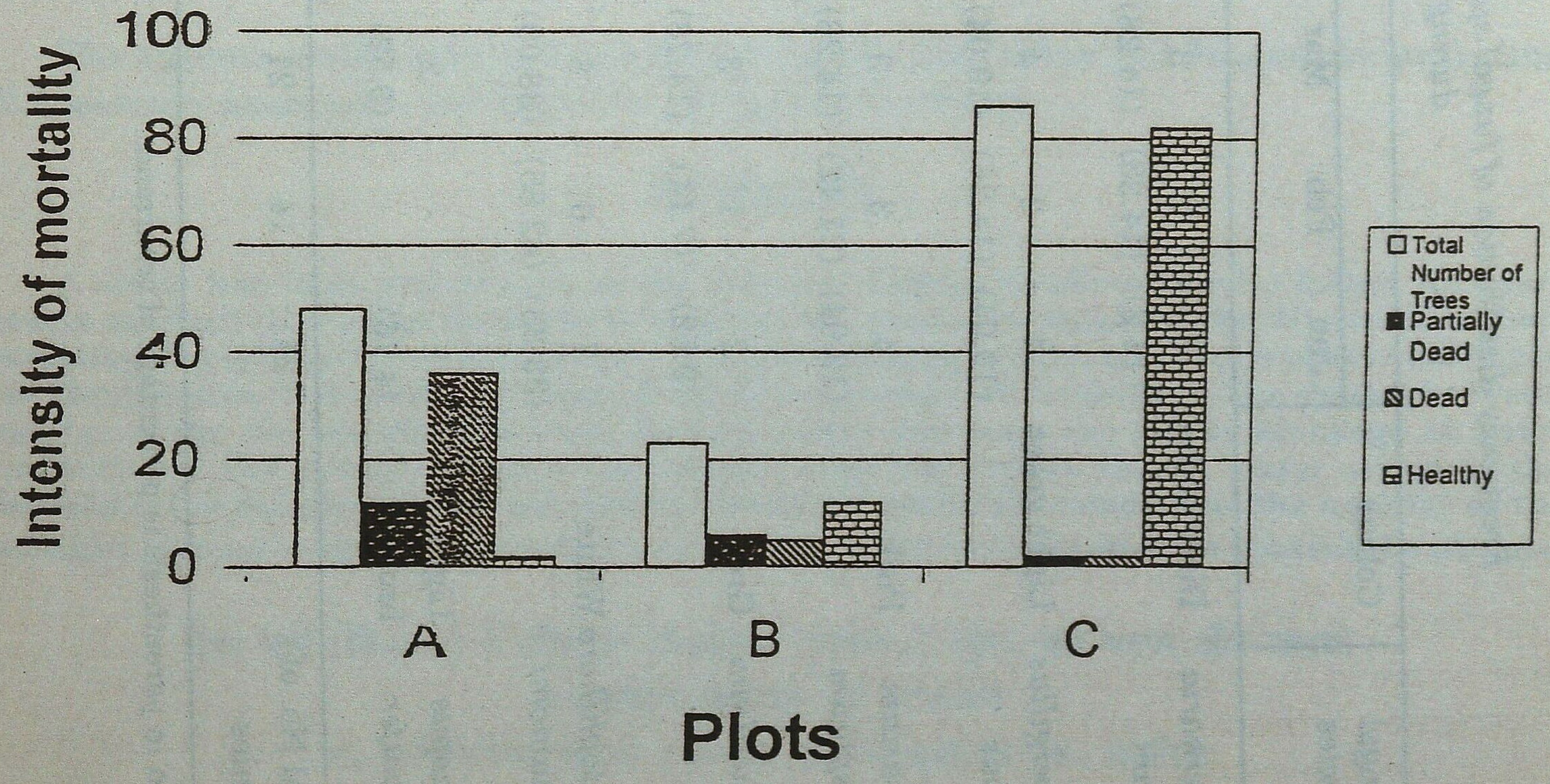
distribution of fungal population showed that *P. cinnamomi* is the abundant pathogen affecting the roots whereas *Fusarium oxysporum, Alternaria solani, Aspergillus, flavus, Penicillium* sp were common and *Rhizopus stolonifer* is occasional (Table 3).

Discussion

The symptoms of the root rot disease include yellowing of the needles, shortening of the needles, easily falling needles and total chlorotic appearance. All the needles of infected trees fall within three to four months of showing the first symptoms of the disease and the tree dies completely soon after. It is assumed that the pathogen *P. cinnamomi* causes the root rot disease and infects the secondary phloem of roots (Dell and Malajczuk, 1989) resulting in water stress in the trees and chlorotic appearance. The trees in Plot 'A' have been reported to be dying/standing dead for the past more than ten years. It seems that this patch showing all dead trees could be the patch getting first infection from where the infection has spread to the adjoining trees. Moreover, Plot 'A' is in depression having the highest moisture percentage. Whereas Plot 'B' is on the slopes along Plot 'A', the Plot 'C' covers the spur with very less moisture percentage. Spread of disease through dissemination of spores up the slopes to plots 'B' and 'C' might be through inoculum transportation by animals and human activity (Shearer and Tippett, 1989). Another way of spread of this disease to the trees in plots 'B' and 'C' seems to the through hyphal contact.

The soil moisture (%) in these three plots showed less soil moisture (%) in the control plot than in diseased plot. The soil moisture favours the sporulation, survival and dispersal of *P. cinnamomi*. Furthermore the impact of environment such as summer rain influences the disease

Fig. 1



Mortality of *Cedrus deodara*

Table 3

Frequency distribution of fungal species presented in the rhizoplane of diseased Cedrus deodara during the period of study (1999-2000)

Fungal species	Colour	1999									Mar. 2000	Frequency (%)	F. Class
		Jan.	Feb.	Mar	Apr	Aug	Sep.	Oct.	Nov.	Dec.			
Alternaria solani	Dirty white	3 (14.2)	2 (14.28)	3 (14.28)	2 (9.52)	2 (8.69)	-	-	-	1 (12.5)	2 (12.5)	70	Common
Aspergillus flavus	Light green	4 (19.04)	2 (14.28)	4 (19.04)	5 (23.80)	5 (21.73)	1 (10.00)	- -	- -	2 (25.00)	2 (12.5)	80	Common
Fusarium oxysporum	Pink	4 (19.04)	3 (21.42)	3 (14.28)	3 (14.28)	2 (8.69)	-	-	-	2 (25.00)	5 (31.5)	70	Common
Penicillium sp.	Grey	2 (9.52)	1 (7.14)	3 (14.28)	4 (19.04)	5 (21.23)	-	2 (20.00)	-	1 (12.5)	1 (6.25)	80	Common
Phytophthora cinnamomi	White	7 (33.33)	6 (42.85)	8 (38.09)	7 (33.33)	8 (34.78)	9 (80.00)	8 (80.00)	8 (88.88)	2 (25.0)	6 (37.5)	100	Abundant
Rhizopus stolonifer	Light brown	1 (4.76)	-	2 (9.52)	-	1 (4.34)	-	-	1 (11.11)	-	-	50	Occasional
Total No. of colonies		21	14	21	21	23	10	10	9	8	16	-	-

Given in parenthesis is percentage of occurrence.

development (Shearer and Tippett, 1989). The major and essential soil nutrients showed that in the control plot is higher than the diseased and infected plots. Available soil nutrients in the plots A&B influences the development and growth of *P. cinnamomi*. As a soil borne fungus belonging to the evolutionary primitive group called the oomycetes or water moulds *P. cinnamomi* completed its life cycle in moist and nutrient enriched soils. As the name "water mould" suggests the life cycle of *P. cinnamomi* depends on moist conditions, which favour its survival, sporulation and dispersal. In autumn season (September and October) and early winter season (November) the percentage of occurrence of *P. cinnamomi* are more than other seasons. It is resulted that when conditions are warm and moist, microscopic spore sacs called sporangia and thick walled chlamydospores are produced vegetatively from mycelial strand in the soil or host tissue. The sporangia release the motile zoospores in free water to infect the host tissue. The pH of the soil is acidic in the control plot and alkaline in the diseased plot indicating that the pathogen influences the soil pH also.

The disease causes severe damage of the entire plant body due to blockage of water conductivity and suppressing the photosynthesis of the needles. The spread of the disease is definitely by root to root contact process, dispersion of spores by cattle and higher soil moisture.

Conclusion

The present study concludes that root rot disease results water stress in *C. deodara* at Chail-Banjhani forest by *P. cinnamomi*, however further studies are needed to develop site specific control measures for the disease.

Acknowledgement

The authors are thankful to State Forest Department, Himachal Pradesh for providing all necessary assistance and facilities during the fieldwork.

SUMMARY

A study has been undertaken in the diseased *Cedrus deodara* (Roxb.) L.Don (Deodar) forests at Chail (Himachal Pradesh) to find out the causative factor of the disease and their mortality. The infected trees showed yellowing, shortening needles and the causative pathogen was identified as *Phytophora cinnamomi* which is causing root rot disease. The rhizosphere soil samples of the disease-affected trees showed higher soil moisture due to blockage of water conductivity. The results of the study explicit that the fungus causes water stress in the diseased trees because of root rot. Under favourable moisture conditions the activity of the pathogen becomes vigorous. However, studies are under investigation to control the disease.

चैल वन (हि०प्र०) में *सिडरस डिओडारा* (राक्स०) लूड० का मरण और उसके कारणभूत कारकों का अध्ययन

ए० कार्तिकयन, जी०एस० गोरय्या, शैलेन्द्र कुमार व एस० कालिया

साराशं

चैल (हि०प्र०) के रुग्ण देवदार (*सिडरस डिओडारा*) (राक्स०/लूड०) वनों के मरण और उनके कारणीभूत कारकों

का पता लगाने के लिए एक अध्ययन किया गया । संक्रमित वृक्षों का पीला पड़ जाना, पत्तियों का छोटा रह जाना होता देखा गया तथा उसके कारणीभूत रोगजन *फायटोरफोरा सिन्नेमोमी* पहचाना गया जिससे वृक्षों की जड़ें सड़ जाने का रोग हो रहा है । रोग प्रभावित वृक्षों से लिए गए राइजोमण्डल के मृदा नमूनों में जल संवाहन रुद्ध हो जाने से उनमें नमी की मात्रा अधिक पाई गई । अध्ययन के परिणाम स्पष्ट करते हैं कि कवक रूग्ण वृक्षों में जल की कमी ला देते हैं क्योंकि वे जड़ों को सड़ा देते हैं । अनुकूल दशाएं रहने पर रोगजनों की क्रियाशीलता बहुत ओजस्वी बन जाती है । तथापि इस रोग का नियन्त्रण करने के उपायों का अन्वेषण कार्य अभी चल रहा है ।

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EFFECT OF OIL CAKE AMENDMENTS ON THE RHIZOSPHERE MYCOFLORA OF *ALBIZIA LEBBEK*

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Introduction

Albizia lebbek is an economically important tree of deciduous forests. The wood is excellent for furniture and agricultural implements. It is also extensively planted under social forestry and other afforestation programmes. Since oil cakes as biological control agent have been found effective in controlling root diseases (Dutta and Hegde, 1995; Prasad *et al.*, 1998), hence it was considered desirable to study the effect of some oil cakes on the rhizosphere mycoflora of *A. lebbek* in relation to plant age.

Material and Methods

Sterilized earthen pots filled with 1 kg of field soil. The soil was amended with oil cakes of *Azadirachta indica* (Neem), *Madhuca indica* (Mahua) and *Gossypium indicum* (Cotton) at the rate of 5 g/kg. After 15 days of waiting period seeds of *A. lebbek* were sown in pots. The pots filled with unamended soil served as control. After 30, 60 and 90 days of sowing the soil around the root zone was drawn to study the rhizosphere mycoflora. There were five replicates of each treatment and the data were subjected to the statistical analysis. Soil plate method was used to isolate fungi from the soil and the population was expressed in the number of organisms per gram of soil (Parkinson, 1957).

Results and Discussion

In all 24 species of fungi belonging to 18 genera were isolated from amended and unamended rhizosphere soil of *A. lebbek* (Table 1). It is interesting to note the initiation of *Aspergillus terreus, A. clavatus* and *Papularia* sp in the soil amended with Neem and Cotton cake, while *A. clavatus* was not observed in the soil amended with Mahua cake. Moreover, these fungi were totally absent in the control. The frequency of *Fusarium oxysporum, Verticillium* sp. *Alternaria tenuis* and *Helminthosporium* sp. was suppressed in the soil amended with Cotton and Mahua cake, whereas in Neem cake treated soil the frequency of fungi was not much influenced. This suppression was observed throughout the period of study. Similar suppression of parasitic fungi and nematodes due to organic amendment have earlier been reported (Singh and Singh, 1994; Raj and Kapoor, 1996; Yasmeen, 1999). The frequency of the saprophytic fungi like *Aspergilli, Pennicillium. Trichothecium* and *Rhizopus* increased considerably in soil amended with oil cakes, except in Mahua cake, where both parasitic and saprophytic fungi were suppressed. The

Table 1

Frequency (%) of fungi in the rhizosphere of Albizia lebbek treated with oil cakes

Fungi	Neem cake Days			Cotton cake Days			Mahua cake Days			Control Days		
	30	60	90	30	60	90	30	60	90	30	60	90
Alternaria tenuis	60	60	40	40	40	20	20	20	-	60	60	40
Aspergillus clavatus	60	40	40	40	40	40	-	-	-	-	-	-
A. flavus	80	60	40	40	60	60	40	40	60	60	40	40
A. luchuensis	80	40	40	80	60	60	40	60	40	40	40	40
A. niger	60	60	60	80	60	40	20	40	40	80	80	-
A. sydowi	40	40	40	60	40	40	60	20	40	40	40	60
A. terreus	20	40	60	60	60	60	20	40	40	-	-	-
Botryotrichum sp.	20	20	20	40	40	60	40	40	40	80	40	-
Cladosporium cladosporioides	80	60	60	100	60	40	60	20	40	100	80	60
Curvularia lunata	40	40	40	20	20	20	20	20	20	60	40	20
Cunninghamella sp.	60	20	20	40	20	20	40	20	20	60	40	40
Fusarium oxysporum	20	20	20	40	-	-	20	-	-	60	80	80
Geotrichum candidum	40	40	40	60	40	40	20	40	40	40	40	-
Helminthosporium sp.	40	60	60	40	40	20	20	20	20	40	60	40
Monilia geophila	60	60	20	60	20	20	40	20	20	40	20	-
Nigrospora sp.	80	60	60	40	40	40	-	20	20	60	40	20
Papularia sp.	60	40	40	-	40	40	40	40	40	-	-	-
Pullularia pullulans	40	40	40	20	40	40	20	20	20	-	40	40
Penicillium notatum	20	40	40	-	-	60	20	40	-	60	40	40
Rhizopus nigricans	60	60	60	80	80	40	40	40	40	40	40	20
Torula alli	40	60	40	60	40	20	40	40	20	-	60	-
Trichothecium roseum	60	40	60	80	40	40	20	40	40	-	60	40
Verticillium sp.	20	20	-	-	20	-	20	-	-	60	60	40
Grey sterile mycelium	20	20	20	60	40	40	40	40	40	20	20	20
Population/g dry soil	72000	74000	77000	70000	72000	75000	55000	57000	60000	65000	70000	72000

total population of fungi showed a significant increase. It gradually increased and reached its highest after 90 days. Despite the suppression of parasitic forms in the rhizosphere of plants grown in oil cake amended soil the total population was significantly higher at each interval as compared to untreated soil except Mahua cake. This may be due to increase in the population of the saprophytic fungi. All the oil cakes were more or less equally effective however, highest reduction in fungal population was observed in Mahua followed by Cotton and Neem oil cake.

The oil cake amendment influence the soil biota in variety of ways. It may suppress the parasitic form through toxic decomposition products or through competition or antagonism resulting from increased microbial activity (Khan *et al.*, 1979).

Acknowledgement

The senior author is thankful to UGC New Delhi for financial assistance.

SUMMARY

Qualitative and quantitative changes in rhizosphere mycoflora of *Albizia lebbek* due to oil cake amendment was studied. In all 24 species of fungi were isolated from the soil. Highest reduction in frequency and population of fungi was observed in soil amended with Mahua cake followed by Cotton and Neem.

एल्बीजिया लेब्बेक राइजोमण्डल के कवक जातों पर खली डालने का प्रभाव

यास्मीन व शमीम एज़ाज़

सारांश

एल्बीजिया लेब्बेक में खली डालने पर उसके राइजोमण्डल के कवक जातों में हुए गुणात्मक और मात्रात्मक परिवर्तनों का अध्ययन किया गया है । कुल मिलाकर मृदा से 24 कवक जातियां पृथक की गई । कवकों की बारम्बारता और संख्या में सर्वाधिक कमी महुए की खली से आती पाई गई, जिसके बाद बिनौले और नीम की खली रही ।

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LINEAR TREE GROWTH MODELS : A LIMITATION OF NEGATIVE ESTIMATION OF SIZE

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Introduction

Linear tree growth models employs linear regression to describe the change in the size/response variate with respect to explanatory variate(s). The response variate may represent tree volume, biomass etc. and the explanatory variate include age, total Height (H), Diameter at Breast Height (DBH), or a combination of these variables say D^2H. To describe the change in response variable (Y) with respect to the explanatory variable (X), the use of linear models is very common in forestry/ agroforestry (Chaturvedi and Khanna, 1982; Jain *et al.*, 1993a, 1993b; Tewari, 1996; Kumar *et al.*, 1996; Jain *et al.*, 1998; Chaturvedi and Sood, 1995). Basically, these models provide the mathematical building blocks of simple/complex biological growth. Had the biological growth process been linear, these growth models could have described the change very precisely. But in true sense the biological growth process is not linear, which is the basic assumption in linear models. Due to this reason, simple linear growth models fails to precisely predict the change in the response variable, particularly for the lower range of explanatory variable. For this range, these models sometimes estimates misleading values and even vague viz. negative values of response variable. This problem associated with linear tree growth models has been addressed as 'negative estimation of tree size' (Ajit *et al.*, 1999).

In this paper, a solution to this problem will be discussed with two proposed conditions for simple linear models. An actual data example will be analyzed for illustration. There will follow a discussion of some issues that arise in inferring from multiple linear regression models.

Model description

The statistical model employed in linear regression is of the form :

$$Y = a + b^*X + \text{error},$$

Where :
Y is the response variate,
X the explanatory variate,
'a' and 'b' are regression coefficients.

Statistical procedure to estimate 'a' and 'b' assumes that the error term is normally distributed with mean zero,

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constant variance and independent between cases (Draper and Smith, 1982). The corresponding mathematical equivalent of simple linear model is the straight line

$$Y = a + b^{*}X,$$

where :
'a' denotes the intercept on Y axis,
'b' the slope of the line (b = tanθ, where θ is the angle which this line makes with the +ve direction of X-axis).

The method of least squares is used to fit this straight line and to estimate the parameters 'a' and 'b' in linear regression using the given data set. There are numerous graphical and statistical methods to support the fitting of the equation and consequently model validation (Janssen and Titus, 1995; Reynolds *et al.*, 1988; Mayer and Butler, 1993; Soares *et al.*, 1995). All of these are based on the comparison of observed and estimated values and the diagnosis of residuals. Once these statistical assumptions are fulfilled the linear model may be used for predictive purposes.

Problem delineation and proposed solution

Employing linear regression to generate the predictive equation is a classical approach using any standard statistical package (SPSS, SAS, STATISTICA or SYSTAT etc). However, a significant number of the linear models reported so far, suffers from the problem of negative estimation of size/volume particularly for lower range of the explanatory variate. The term 'negative estimation of size', meant that the estimated value of the dependent variable comes out to be negative for a small range of values of independent variable. The simple linear model (with one independent variate) involves two parameters 'a' and 'b'. The four possible cases for the signs of 'a' and 'b' along with the interpretation of each case was shown in Table 1. The only case, where

Table 1

Possible signs of 'a' and 'b' for simple linear regression model $Y = a + bX$

Numerical sign of 'a'	Numerical sign of 'b'	Remarks with interpretation of the case	
+	+	OK :	The predictive values will be non-negative for all values of explanatory values
+	-	Not Possible :	This combination of signs leads to continuous decline in response variable, not the growth.
-	-	Not Feasible :	It projects that all Y's are negative, which can never be the case
-	-	OK with Lower Bounds :	When the condition of lower bound on the explanatory variable is imposed, it predicts non-negative values of response variable. Thus, solves the problem of negative estimation of volume.

'a' is negative and 'b' is positive may induce the negative estimation problem. As a curative measure, it is suggested that the following conditions should be satisfied so that the estimated value of size would always be non-negative.

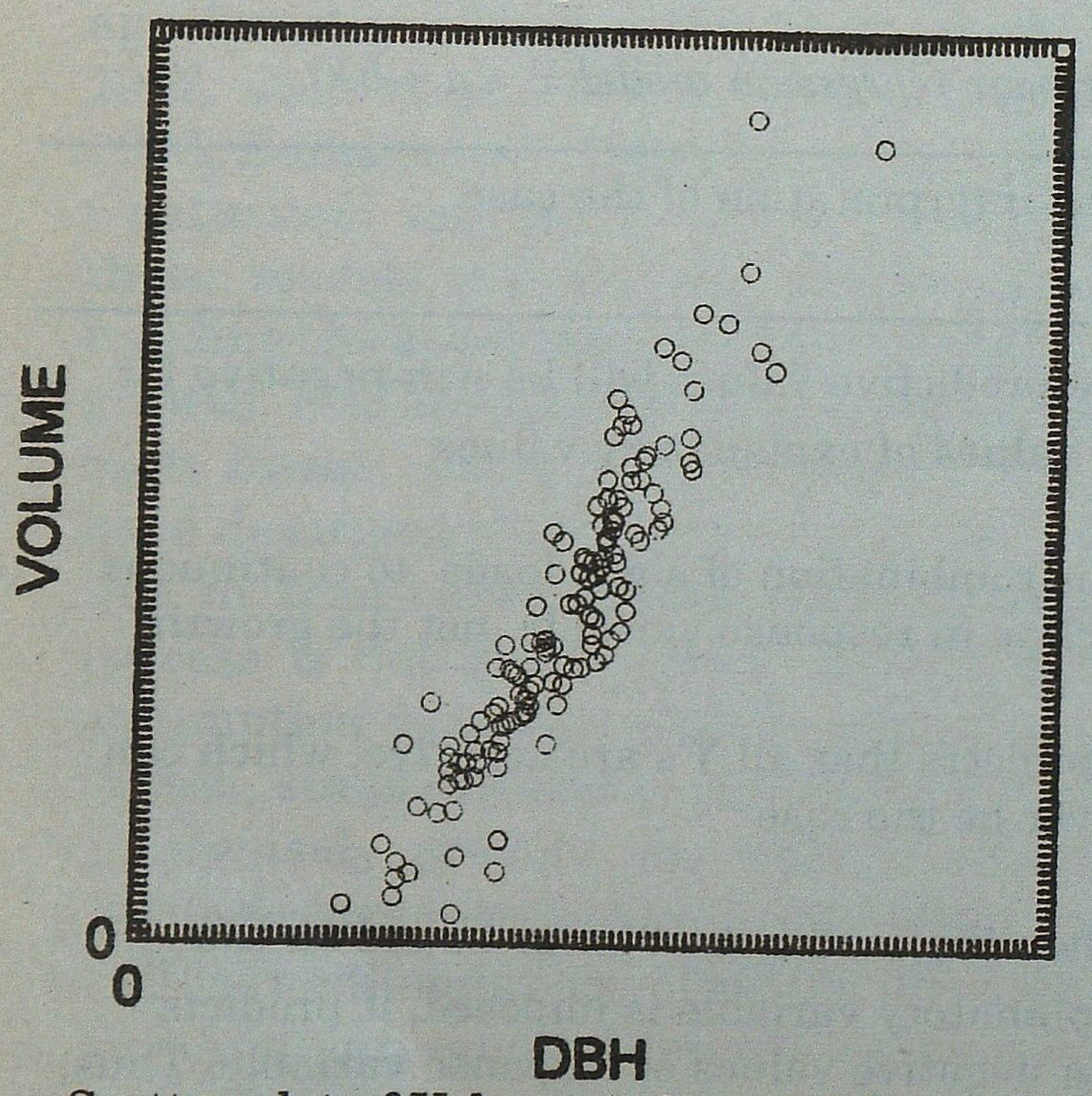
(1) dy/dx should be non-negative i.e. dy/dx>0
(2) bx>a i.e x>(a/b)

Actual data example

To illustrate the problem with an example, a scatter plot of data depicting the volume (m^3) vs DBH (cm) is given in Fig.1. The linear regression performed on this data set gives the equation : Volume = -0.0314+0.007237*DBH with Adj. R^2=0.92. For this fitted line the residual diagnostics were evaluated. All the regression assumption were fulfilled by this line. Thus the fitted equation satisfied the criteria of good R^2 values and fulfilled the regression requisites, but still predicted negative values of volume, particularly for DBH values less than 4 cm. Examining the proposed set of conditions for this equation, (1) dy/dx>0 as b=+.007237 and (2) for X > (.0314/.0072370) the predictions are all non-negative and DBH = 4.33 cm comes out to be the lower bound of the explanatory variate.

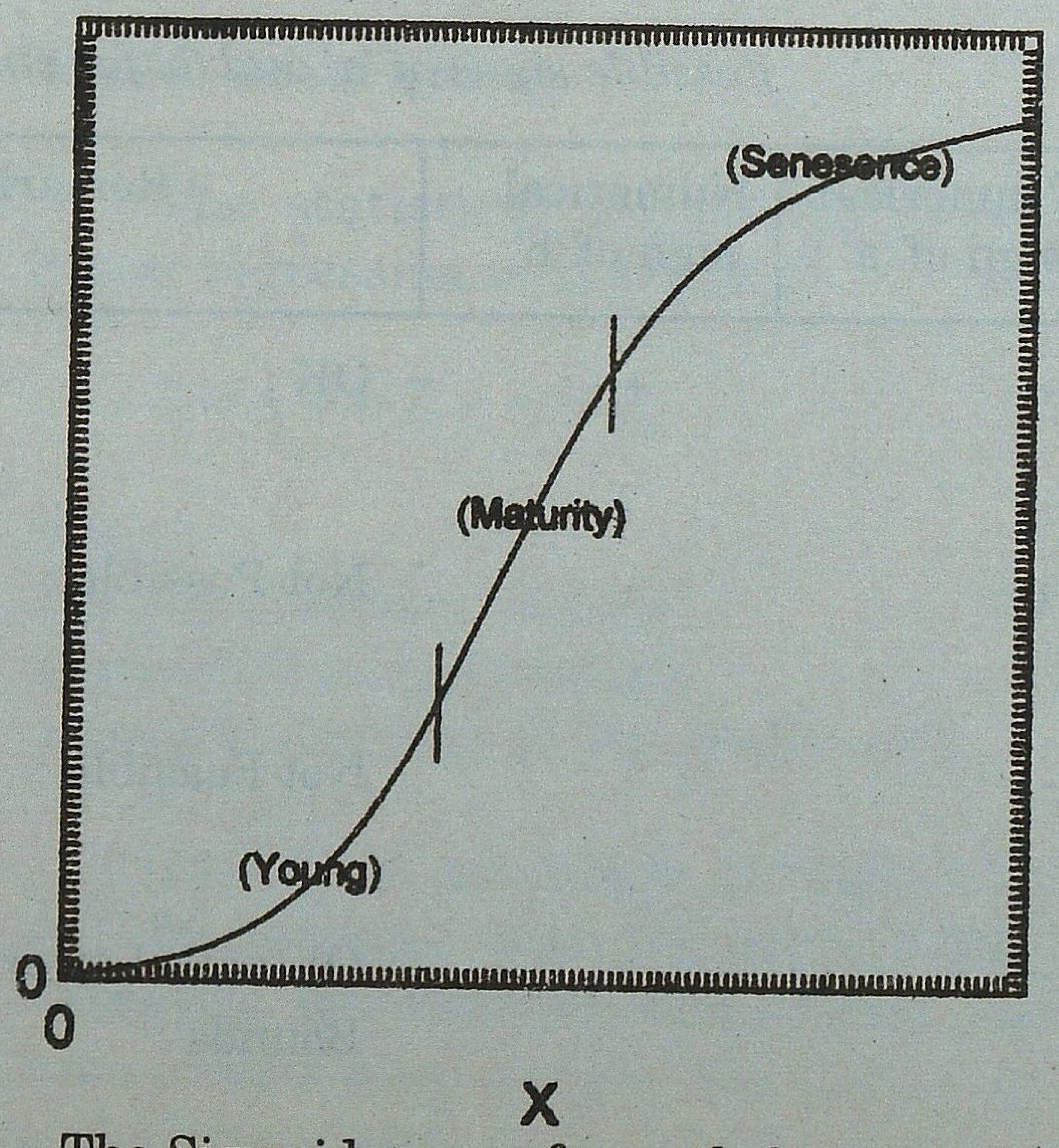
Thus, the linear model reflects a slightly unrealistic picture of tree growth, which is sigmoid in nature. Growth of the tree results from two opposing factors: firstly the positive component associated with biotic potential, photosynthesis activity, absorption of nutrient, constructive metabolism etc and secondly the negative component representing the restraints imposed by competition, limited resources, stress, respiration and aging factors. These two components when combined together results in the sigmoid shape of tree growth. The three phases of the tree growth are depicted in Fig. 2.

Fig. 1



Scatter plot of Volume (m^3) vs. DBH (cm)

Fig. 2



The Sigmoid curve of growth function

Table 2

Possible signs of 'a' and 'bi' for multiple linear regression model $y = a + \sum_{i=1}^{n} b_i x_i$

Numerical sign of 'a'	Numerical sign of 'b_is' (i= 1,2...n_1), n_2....n)		Condition to be satisfied for non-negative estimation of response variable
	b_i=1,2...n_1	b_i=n_2,...,n)	
+	+	-	$a + \sum_{i=1}^{n1} b_i x_i > \sum_{i=n2}^{n} b_i x_i$
-	+	-	$\sum_{i=1}^{n1} b_i x_i > a + \sum_{i=n2}^{n} b_i x_i$

Table 3

Some linear model equations along with the proposed lower bound

Model description	Reference	Lower bound to be imposed on explanatory variate
TMOB = -0.073486+0.00002595*D^2H (R^2=0.99) Total over bark volume of Neem	Jain *et al.*, 1998	2831.83
BB = -8.747+3.336*DBH (R^2=0.83) Bole biomass of *Populus deltoides*	Toky *et al.*, 1994	2.62
TV = -0.00458+0.0000361*D^2H (R^2=0.99) Total volume of *Eucalyptus* spp.	Jain *et al.*, 1993	126.87
DBH = -3.1122+1.1672*Age (R^2=0.58) DBH of Ban oak	Singh *et al.*, 1998	2.67

The apparent reason for 'negative estimation of size' with linear models (Singh *et al.*, 1998; Jain *et al.*, 1993a, 1993b; Toky *et al.*, 1994; Raj and Cheema, 1990; Jain *et al.*, 1998; Gupta *et al.*, 1996; Jain *et al.*, 1996) even with satisfactory R^2 values is that the data set utilized to fit the regression equation represents that range of explanatory variable, belonging to the second phase of growth and which is linear in nature. However, when we use this linear equation for interpolation/extrapolation particularly for lower range the results of prediction are not encouraging and some times vague viz. negative estimation of size. In the last phase (third) they lead to

overestimation of size. The description of some of the reported simple linear models along with the proposed bound for non-negative estimation of size is presented in Table 3.

Extension to multiple regression

In case of multiple linear regression (utilizing more than one explanatory variables), the situation becomes slightly complicated and the solution is not trivial. The general form of the multiple linear regression equation is

$$y = a + \sum_{i=1}^{n} b_i x_i$$

Where, Y is the response variate, X_i's are explanatory variate, 'a' and 'b_is' are regression coefficients. In this equations the coefficients 'a' and 'b_is' can be + ve or -ve. Suppose the n 'bi$_i$s' coefficients can be divided into two mutually exclusive sets containing n_1 (from 1 to n_1) and n-n_1 (from n_{i2} to n) number of points respectively, then the possibly cases of composite signs of 'a' and 'b_is' along with the interpretation of each case was shown in Table 2. However in case of multiple linear regression, straight bounds can not be put on explanatory variables as was in simple linear regression.

Conclusion

The apparent reason for high R^2 values associated with linear models is that the data set usually belongs to the second phase of tree growth and which is linear in nature. However, reckoning into the prediction capabilities of these models, the results are not encouraging. For the initial (first) phase of tree growth they result in underestimation and even negative estimation and for the last phase (third) they lead to overestimation of size. It is therefore recommended that linear models, in context of tree growth, should be used with caution and in case the fitted simple linear equation results in negative value of 'a' and positive value of 'b', then the lower bound of explanatory variable should be computed as proposed in condition-2 (X>b/a) to avoid the negative estimation of tree size. Thus when the phenomenon is inherently undesirable, as the negative estimation of size in simple linear models for lower range of explanatory variable, to put implied lower bound on the raw values is most appropriate.

SUMMARY

The use of linear tree growth models, to describe the change in the size/response variate viz volume, biomass) with respect to the explanatory variate (height, diameter at breast height, age), is very common in forestry/agroforestry. However, these models may sometimes lead to misleading predictions viz 'negative estimation of size' exclusively for lower range of the explanatory variate. This study elaborates this issue and a feasible solution is proposed to overcome this problem. It is contrived that when the phenomenon is inherently undesirable, as the negative estimation of size in simple linear models for lower range of explanatory variable, to put implied lower bound on the raw values is most appropriate.

रेखीय वृक्ष वृद्धि मॉडल–आकार के नकारात्मक अनुमान की सीमाएं

अजित, पी०एन० श्रीवास्तव, वी०के० गुप्त व के०आर० सोलंकी

साराशं

स्पष्टीकरण विचर (ऊंचाई, वक्षोच्चता पर व्यास, उम्र) के सन्दर्भ में आकार/प्रतिचार विचर (अर्थात् आयतन, जैवपुंज)

में हुए परिवर्तन को वर्णित करना रेखीय वृक्ष वृद्धि मॉडलों का वानिकी/कृषि वानिकी में आम चलन है। किन्तु कभी-कभी ये मॉडल भ्रामक परिणामों पर भी पहुंच सकते हैं जैसे कि आकार का नकारात्मक अनुमान लगाना खासतौर से स्पष्टीकारक विचर की निम्नतर परिसीमाओं के लिए। यह अध्ययन इसी मसले को स्पष्ट करता है और इसका संभाव्य समाधान इस समस्या पर पार पाने के लिए प्रस्तावित किया गया है। बताया गया है कि स्थिति यदि निहिततः अवांछनीय प्रतीत हो जैसी कि सरल रेखीय मॉडलों में स्पष्टीकारक विचरों की निम्नतर परिसीमाओं के लिए उनका नकारात्मक अनुमान निकलना तो कच्ची अर्हाओं पर निचली ओर जाने वाली अर्हाओं पर कुछ निहित आरोप लगा देना, सबसे अधिक उपयुक्त रहता है।

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DRIED-FLOWERS MAKING - A POTENTIAL COTTAGE INDUSTRY IN NORTH-EAST INDIA

A.A. MAO*

Introduction

North-East India comprising the States of Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland and Tripura is only 8% of the total geographical area of India. The region is considered the richest in plant diversity and harbours about 50% (*ca.* 8,000 spp.) of the total floral wealth of India. North-East India with its diverse and rich natural forests harbours several plant species which are ideal for making dried-flowers. Furthermore, the region with its varied climatic conditions creates a congenial atmosphere for cultivating many ornamental plants suitable for making dried-flowers. However, in spite of the rich plant resources, so far, no available record in respect of dried-flower making from the region. Hence, the present paper attempts to highlight dried-flowers making - a potential cottage industry in North-East India which is not so far popular in the region. A list of plants from the region which are ideal for dried-flower industry and the methods of making dried-flowers, is also given.

Materials

North-East India is bestowed with diverse plants, flowering throughout the year, such that each season brings new excitement for a dried-flower lover. An enormous amount of plant materials can be preserved so that these retain much of their fresh, glowing colour and form. Some common plants from the region which can be simply air dried to make dried-flowers are listed below :

Asteraceae :
Anaphalis contorta Hook.f.
Helichrysum spp.
Montanoa bipinnatifida C.Koch.

Cyperaceae :
Cyperus sanguinalentus Vahl.
C. polystachyus Rottb.
C. cephalotes Vahl.
C. globosus All. var. *khasianus* C.B. Cl.
C. cuspidatus H.B.K.
C. platystylis R.Br.
C. pulcherrimus Willd., ex Kunth.
C. distans L.f.
C. nutans Vahl.
C. ditalus Vahl.
Eleocharis congesta D.Don
Fimbrystylis griffithii Bocek.
F. barbata (Rottb.) Benth.
Lipocarpha argentea R.Br.
L. chinensis (Osb.) Kern.
Maricus compactus (Rtz.) Druce

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Scirpus mucronanthus L.
S. articulatus L.

Eriocaulaceae :
Eriocaulon brownianum Mart.
E. cristatum Mart. var. *mackii* Hook.f.

Lamiaceae :
Nepeta spp.

Lycopodiaceae :
Lycopodium spp.

Papaveraceae :
Poppy fruit/pot

Poaceae :
Grasses

Ranunculaceae :
Climatis spp.

Ferns spp., etc.

Methods

The procedures for making dried-flowers are given as follows :

Harvesting

All plant materials should be picked in dry weather, preferably around or after midday, when any dew will have evaporated. Flowers should be picked approximately four days before they reach their prime. In other words, a rose should be picked when the bud is colourful and on the point of opening.

Drying Flowers

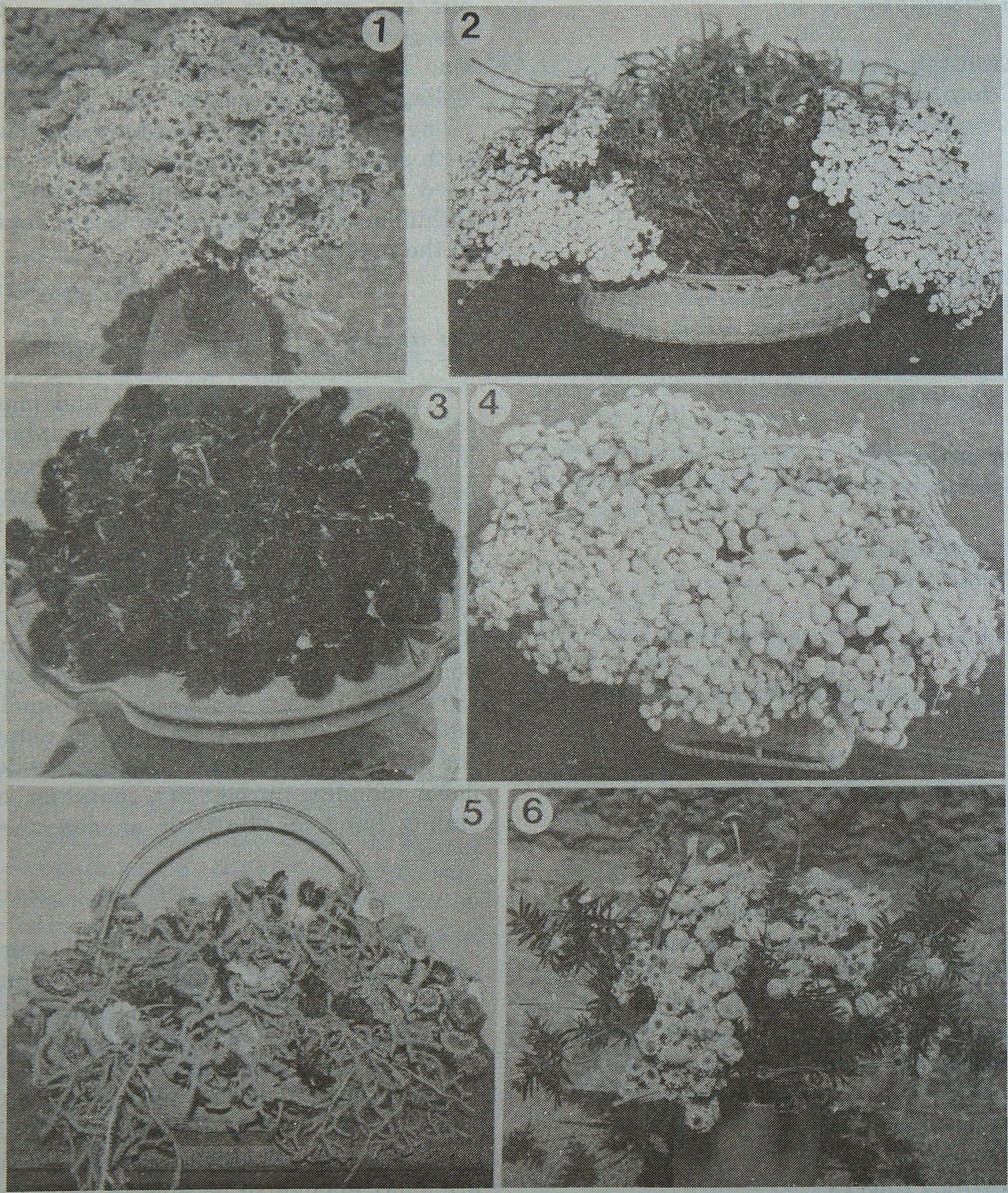
Plant material can be air-dried by hanging the stems in bunches on the walls and from the ceiling. The other way of preserving plant materials is by drawing out the moisture from flowers with desiccants like silica gel, alum and borax. One also press flowers in a press or book. Foliage can be preserved with glycerine. Many flowers and leaves can be crystallised with sugar, gum arabic or egg white and used to decorate cake and biscuits. The technique of air drying is described in detail in the present paper.

Air drying

Air drying is the easiest and most effective method of preserving plant material. Ideally, plant materials should be air-dried in a room or cupboard without a moving air current. However, it is imperative that the drying room is both dry and dark. If it is not dry, the plant material will rot, especially where the stems or flowers are touching, such as at the tying point of a hanging bunch. If the room is not dark, the flowers will fade extremely quickly. Depending on the type of plant, the material can be dried hanging upside-down, standing upright in a container, or simply lying on the floor as described below :

(i) *Hang drying* : Hanging material to dry is the most common method of air drying. Before hanging the materials, remove all the lower leaves and wipe away any moisture on the stems with kitchen paper or towel. Then tie the stems together into bunches with lengths of string or elastic band. Make sure the stems beneath the tie are short enough to be able to hang the bunches upside-down in position. Fan out the flowers, seed-heads and leaves in each bunch so that there is as little contact between the leaves and petals as possible.

Fig. 1-6



1. A bunch of *Anaphalis contorta*. 2. A basket of *Eriocaulum brownianum*, *Lycopodium japonicum* and *Nepeta lamiopsis*. 3. A pot of dried fruit of *Montanoa bipinnatifida*. 4. A basket of *Eriocaulum brownianum*. 5. A basket of *Helichryssum* sp., *L. japonicum* and *N. lamiopsis*. 6. A vast of *Cyperus* sp., *A. contorta* and *E. brownianum*.

Then attach the bunches or single stems upside-down to a rail, wire or length of string in the drying place. Hang the groups of bunches so that they do not touch one another. It is better to dry a few flowers well than dry many flowers so badly that you are presented with a disaster area of decay.

Check the flowers from time to time as they are drying. Different plants take different amount of time to dry. Some plants dry quite quickly in about three weeks, some a little longer, while some may take several months. Do not be tempted to take the flowers down before they are completely dry, or the stems will soon droop and flowers disintegrate.

(ii) *Drying upright* : Some material air dried well when placed upright in a container. Grasses, rushes, cereals and many other seed-heads dry perfectly if left to stand in an empty vase. They can even be arranged just after picking and left to dry in position. As with hanging bunches, the material need to stand in a cool dry, well-ventilated, dark place for best results.

(iii) *Drying Flat* : Some plant materials can simply be laid on the floor or in a box to dry in this way, although the leaves will develop crinkly edges. Moss and fir cones can be laid in an airy box or basket to dry and larger heads of plants such as...etc on a chicken-wire shelf.

Arranging Dried-Flowers

No special technique is involved in arranging dried-flowers. It requires just common sense and creativity like that of arranging fresh flowers. However, now a days different colour sprays are available in the market with which one can simply spray on the dried-flower head to add colours to ones desired.

Discussion

Dried-flower is popular in many parts of the world, especially in Western countries. Many people in Western countries do it either as a hobby or as a profession. Dried-flowers are beautifully arranged in baskets or containers and usually sold in the market at high prices. In India, it might not be as popular as in the West, however there is a great demand for dried-flowers in recent years especially in big cities like Delhi, Bombay, Calcutta, Bangalore, etc. Well dried-flowers looks almost alike the fresh ones, and they can last for many months to years if maintained properly. Today, the price of a basketful of well-arranged dried-flowers ranges from Rs. 100/- to Rs. 500/- or more depending on the type of flower. Sometimes the dried flowers are sold as per each flower head and their price also varies from flower to flower. In North-East India, so far, it may be said that Nagaland State leads in dried-flower making. Many flowers are dried and sold in the market in Kohima and they even supply to Delhi, Calcutta, etc. A handful bunch of dried statice flower cost something between Rs. 50/- to 150/- and dried *Helichryssum* flower is sold for Re.1/- to Rs. 2/- per flower head in Kohima local market. Recently many people in Shillong (Meghalaya) have also taken interest in dried-flowers making. At present, the most common and popularly used flowers in dried-flowers from North-East India are the flowers of *Anaphalis contorta* (Fig. 2), *Eriocaulon* spp. (Fig. 4), *Helichryssum* spp. (Fig. 5), *Montanoa bipinnatifida* (Fig. 3), statice, grasses, etc.

North-East India with its rich forest

flora offers a great opportunity for making dried-flowers a cottage industry. There are so many flowers in the region which can be used for making dried-flowers apart from the few plants listed in this paper. Furthermore, the industry has a good scope with the opening up of tourism industry in the region. Therefore, proper planning and setting up marketing facilities for this product will greatly encourage the people in the region. Hence, the State Governments and Non-Governmental Organisations in the region should take the initiative in popularisation of this potential small cottage industry which will generate revenue and self-employment to the people.

SUMMARY

North-East India is one of the richest in plant diversity in India and harbours many flowering plants throughout the seasons, which are excellent for making dried-flowers. Dried-flowers making can be a potential small cottage industry for the region. This paper presents for the first time a list of plants suitable for dried-flowers making and the techniques of dried-flowers making.

शुष्क–पुष्प बनाने में – पूर्वोत्तर भारत में एक सक्षम कुटीर उद्योग

ए०ए० माओ

साराशं

पूर्वोत्तर क्षेत्र वनस्पद्दि विविधताओं में, भारत में सबसे सम्पन्न है और यहाँ हर मौसम में फूलने वाले अनेक पौधे मिलते हैं, जो शुष्क–पुष्प बनाने के लिए बहुत उपयुक्त है । आर्किड के शुष्क–पुष्प बनाने के लिए इस क्षेत्र में कुटीर–उद्योग की क्षमता है । यह अभिपत्र इस प्रकार का पहला है जिसमें शुष्क–पुष्प के लिए उपयुक्त पौधों की सूची तथा उनको सुखाने की विधि का वर्णन किया गया है ।

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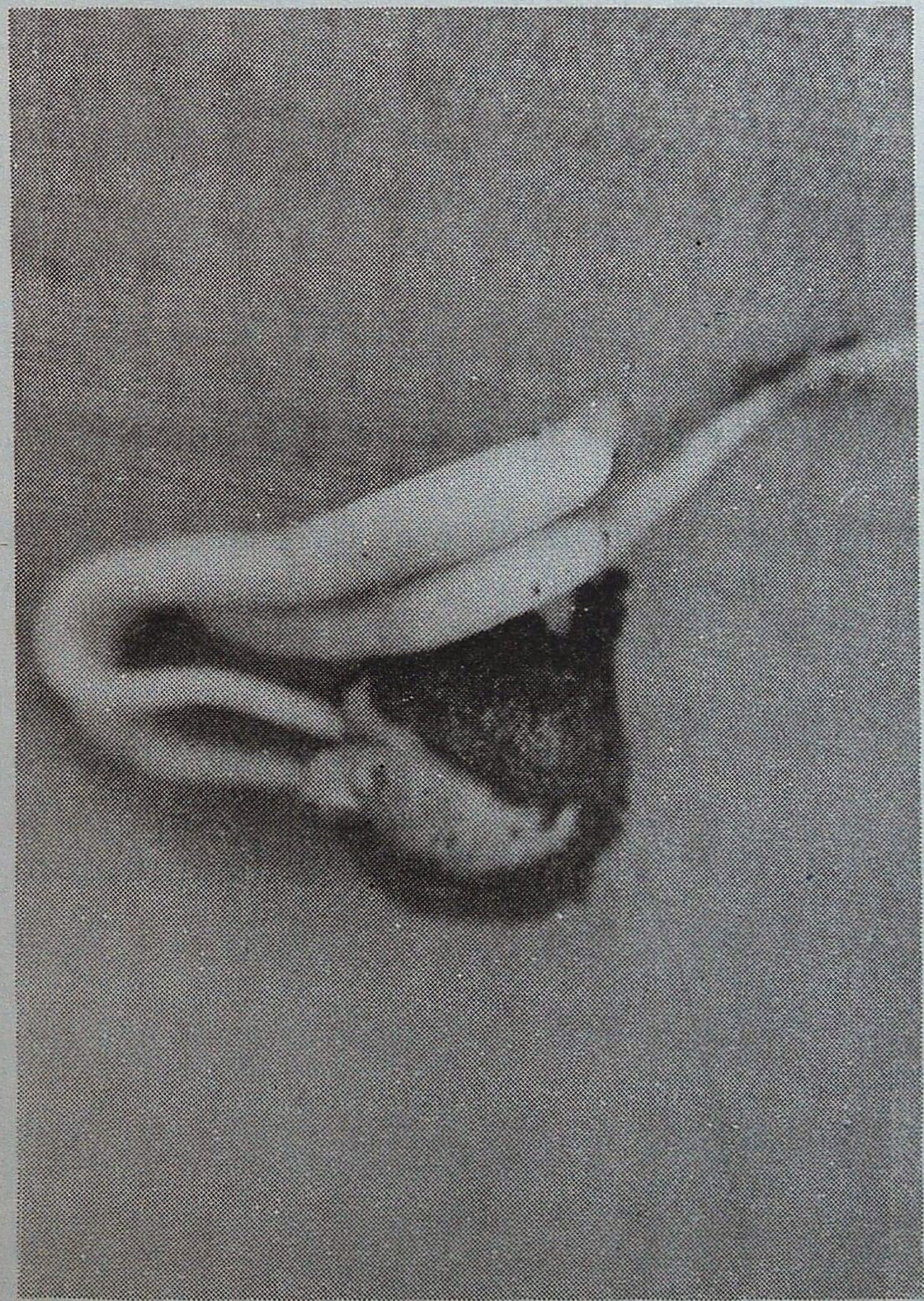
RESEARCH NOTES

(I)

OCCURRENCE OF SYMBIOTISM AND TWIN SEEDLINGS IN *SANTALUM ALBUM*

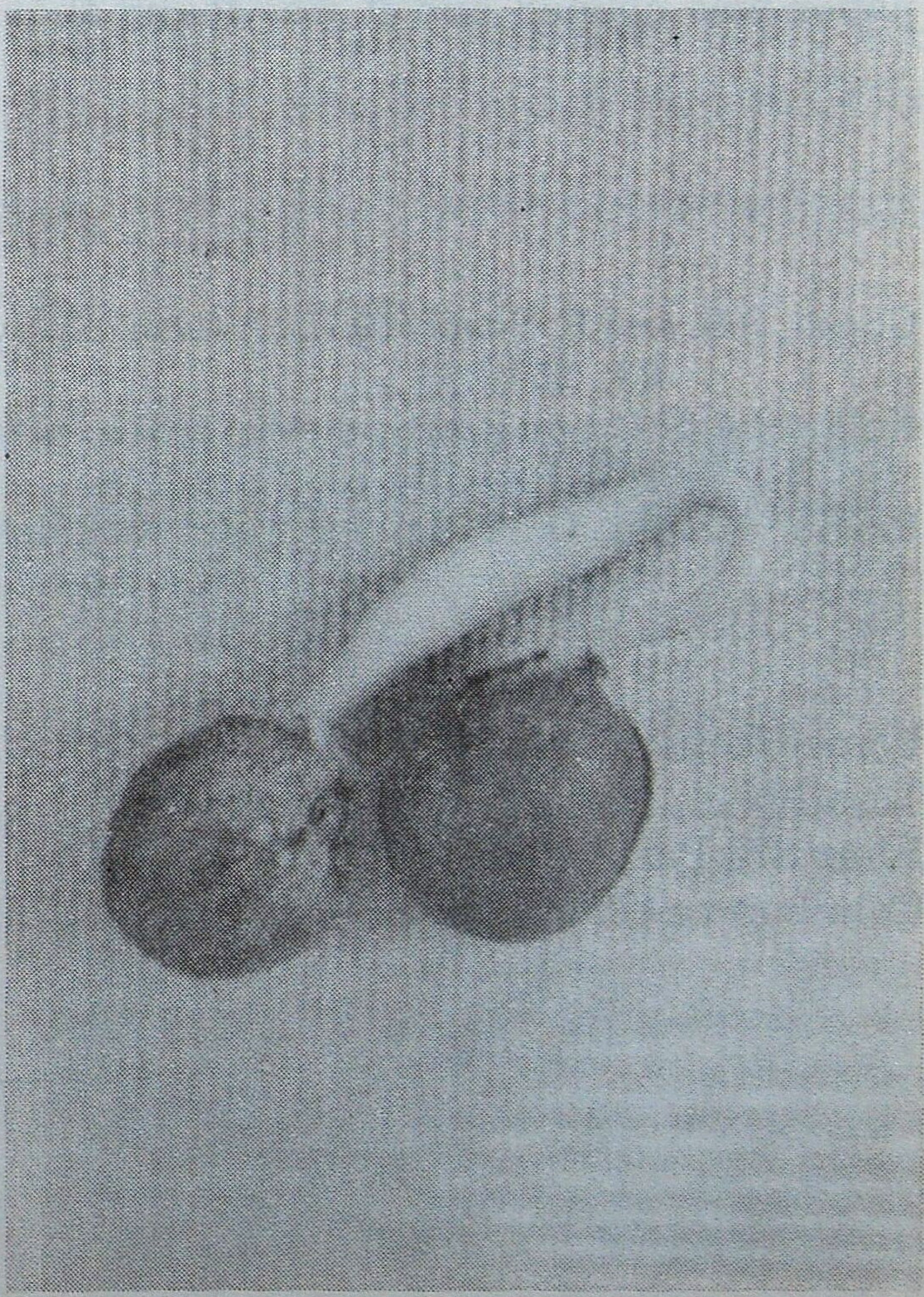
Sandalwood is the fragrant heartwood of species of genus *Santalum* (Family - Santalaceae). In India the genus is represented by *Santalum album* Linn. Its wood commercially as "East Indian Sandal Wood" and essential oil from it as "East Indian Sandal Wood Oil" are among the oldest known perfumery materials. In India *Santalum album* is found all over the country with over 90% of the area in Karnataka and Tamil Nadu, covering 8,300 km^2. In Karnataka it grows naturally in the

Fig. 1



Twin seedlings in *Santalum album*

Fig. 2



Parasitic approach in *Santalum album*

Southern as well as Western Parts over an area of 5,000 km^2. In Tamil Nadu it is distributed over an area of 3,000 km^2 and dense population exists in North Arcot (Javadhi and Yelagiri hills) and Chitteri hills. The other States where Sandal trees are found are Andhra Pradesh, Kerala, Maharashtra, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh, Bihar and Manipur.

Sandal fruits were collected fresh from the best base population tree as soon as they have fallen on the ground during April and May. They were soaked in water and rubbed to remove the soft pulp. Before sowing on the ground the seeds were wrapped in the paper the wet seeds were dried under shade for few days. After the germination period of 48 days the wrapped paper was opened and it was found that 53% germination has taken place with the emergence of twin seedlings (Fig. 1). Polyembryony is the occurrence of more than one embryo in a seed (Ghosh and Sashi, 1957). This research note is on the notice of one such occurrence in *Santalum album*, which of course is a rare phenomenon (Kulkarani and Srimathi, 1981). It has also been observed that twin seedlings were having standard growth in comparison in single embryo (Raghu Ramulu *et al.*, 1999). So far double seedlings were found in sand media but here twin seedlings emergence took place in the wrapped paper. Another interesting phenomenon, which the authors came across, was the parasitic approach in *Santalum album* where the root system of one seedling has entered into the neighboring seed of the same species for life support (Fig. 2).

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(II)

OCCURRENCE OF ALBINO SEEDLING IN *SALVADORA OLEOIDES* DECNE.

Salvadora oleoides (Decne) is a small tree with twisted stem and drooping branches, found mostly in the hyper arid regions of Western Rajasthan and Gujarat. It is of great significance, considering its ability to withstand harsh climatic conditions. *S. oleoides* is an evergreen tree of alluvial plains of Western Rajasthan and has been considered climax vegetation in the extreme arid region (Mertia, 1990). It produces profuse flowering in the month of March-April and the fruits ripen by May-June. The fruits commonly called as 'Piloo' have a pulpy covering and are edible. The pulp consists of high contents of glucose, fructose and sucrose. The seeds are rich in fats and used extensively as row material for soap manufacturing. Also, the leaves are nutritious and palatable to camels and are considered to increase body weight and milk yield.

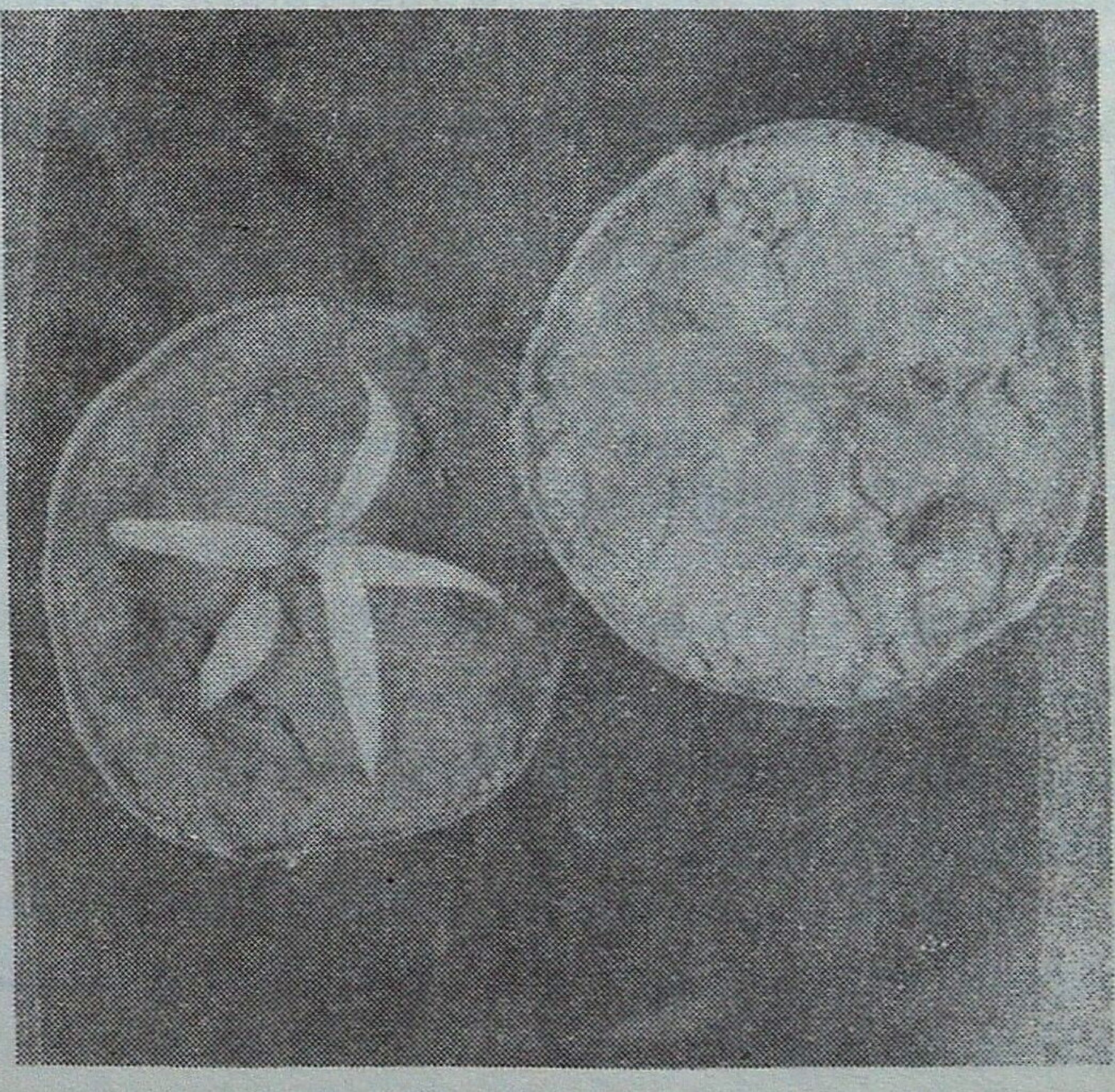
Inspite of its importance as a potential tree species for revegetating extreme arid areas. Practically very little information is available regarding this species. In nature regeneration of *S. oleoides* is very rare through seeds. This could be possibly due to the coincidence of fruit maturity and rainy season which causes considerable damage due to fungal or other disease.

In the present study, an attempt has been made to study the germination behaviour in *S. oleoides*. Petridish trials revealed earliest germination within 13 hours and 100 per cent germination was observed within 26 hours of setting of experiment.

Albinism is a rare phenomenon exhibited by plants with characteristic absence of chlorophyll and subsequent white colour of entire seedling. Reports regarding the occurrence of albinism in the tree seedlings are very scarce (Venkatesh and Emmanuel, 1976). However, this has been reported in trees such as *Eucalyptus tereticornis, E. camaldulensis* (Venkatesh and Sharma, 1974), *Pinus roxburghii* (Venkatesh and Thapliyal, 1977) and *Pterocarpus santalinus* (Vakshasya, 1981).

The phenomena of albinism is strongly

Fig. 1



Albino and normal seedling in *S. oleoides*

genetically controlled. The gene responsible for albinism is recessive and those genotypes which are homozygous recessive do exhibit this character. This happens when plants with heterozygous genotypes are crossed. This may also result when such heterozygous albino carriers (Aa) are self fertilized.

In our germination study with *S. oleoides* seeds, it has been observed the rare occurrence of a pure albino seedling. It remained healthy upto 20 days with four sets of leaves, and thereafter weakened and died due to the unavailability of chlorophyll (Fig. 1). According to (Vakshasya, 1981) the gene responsible for albinism might have evolved in the genetic make up of these plants in the course of time. This process of genetic recombination, might have resulted in such homozygous recessive conditions in the subsequent generations.

In the present study seeds were collected from a number of widely distributed trees. The chance of any tree with albino carrying genotype (Aa) is very low. Had it been so, there would have been more number of albino seedlings. Hence, the albino seedling which we have observed could be a result of spontaneous mutation which might have occurred at some stage between seed formation and seed germination. It is an observation of interest, as in case, if someone is able to spot an individual plant in the population which is a carrier (Aa) for this trait and estimates of natural selfing can be made using albino seedling as genetic marker as has been done in slash pine (Squillance and Kraus, 1963).

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(III)

EFFECT OF DIFFERENT FUNGICIDES ON STORAGE FUNGI AND GERMINATION OF *ACACIA CATECHU* WILLD.

Introduction

Acacia catechu commonly known as Khair is used for fuel, fodder, timber and katha. This species is propagated through seed which are attacked by a variety of pathogens viz., fungi, bacteria and viruses. Among them fungi are the sole cause of seed spoilage in storage. Thus the present investigation were conducted to evaluate the effect of different fungicides on storage fungi and germination of *Acacia catechu*.

Material and Methods

To carry out the present investigation, seeds were treated with four fungicides as per their recommended doses individually viz., Bavistin, Captan, Indofil M-45 and Streptocycline @ 0.05%, 0.2% 0.2% and 100 ppm, respectively as well as in combination i.e. Bavistin (0.025%) + Indofil M-45 (0.1%), Bavistin (0.025%) + Captan (0.1%), Bavistin (0.025%) + Streptocycline (50 ppm), Captan (0.1%) + Indofil M-45 (0.1%), Captan (0.1%) + Streptocycline (50 ppm) and Indofil M-45 (0.1%) + Streptocycline (50 ppm) for their efficacy in controlling the seed borne microflora. An untreated seed lot was kept as control. Four replications of 100 seeds each were kept for germination is germinator maintained at a temperature of 25°C and RH of 94-96%. Observations on seed germination was recorded 7 days after sowing and for seedling infection on alternate days upto 28 days. Distribution of microflora were assessed by using standard blotter method and identification was done by using standard procedure of ISTA (Anon., 1976).

Results and Discussion

Although seeds lose their viability and even die in storage through natural ageing, storage fungi, such as species of *Aspergillus* and *Penicillium* are also known to contribute significantly towards reduction in the viability or death of seeds (Singh and Mathur, 1993). In the present investigation, seed treatments with various fungicides inhibited growth of seed microflora, but to varying extent. The differences among the treatments were found non-significant statistically, therefore, on the basis of general mean analysis, it was found that the germination was highest in case of seeds treated with Indofil M-45 (52%), over the control (20.5%), followed by Bavistin + Indofil M-45 (48.50%) and Bavistin + Streptocycline (47%). Similar results in *Acacia nilotica* were reported by Mehrotra and Singh (1998). However, combination of Bavistin (0.025%) + Streptocycline (50 ppm) was found best to control fungal as well as bacterial infection in *Acacia catechu*.

Table 1

Effect of Fungicides on germination and storage fungi of Acacia catechu Willd.

Fungicide	Conc. (%)	Germination (%)*	Fungal incidence (%)*		Bacterial Infection(%)*	Hard Seeds(%)*
			*Aspergillus**	*Penicillium**		
Bavistin	0.05	31.00	8.50	4.5	6.0	50.0
Captan	0.20	40.50	10.50	5.0	6.0	38.0
Indofil M-45	0.2	52.00	15.50	6.0	8.5	18.0
Streptocycline	100 ppm	29.50	24.00	6.0	1.0	39.5
Bavistin + Indofil M-45	0.025 + 0.1	48.50	19.00	6.0	6.5	20.0
Bavistin + Captan	0.025 + 0.1	45.50	17.00	6.0	7.5	24.0
Bavistin + Streptocycline	0.025 + 50 ppm	47.00	7.00	2.0	0.5	43.5
Captan + Indofil M-45	0.1 + 0.1	40.50	10.00	3.5	7.5	38.5
Captan + Streptocycline	0.1 + 50 ppm	45.00	8.50	5.5	3.0	38.0
Indofil M-45 + Streptocycline	0.10 + 50 ppm	43.50	11.50	4.5	2.5	38.0
Control	-	29.50	35.00	12.5	9.5	13.0

*Mean values of four replications.

Conclusion

Studies were carried out on different fungicides along as well as in combination to evaluate their effect on storage fungi and germination of *Acacia catechu* Willd. Seed treatment with Indofil M-45 (0.2%) alone gave maximum germination of 52 per cent. Bavistin (0.025%) + Streptocycline (50 ppm) was found best to control fungal as well as bacterial infection.

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(IV)

POLYEMBRYONY IN *SYZYGIUM CUMINI* (L.) SKEELS AND IN *VATERIA INDICA* L.

Introduction

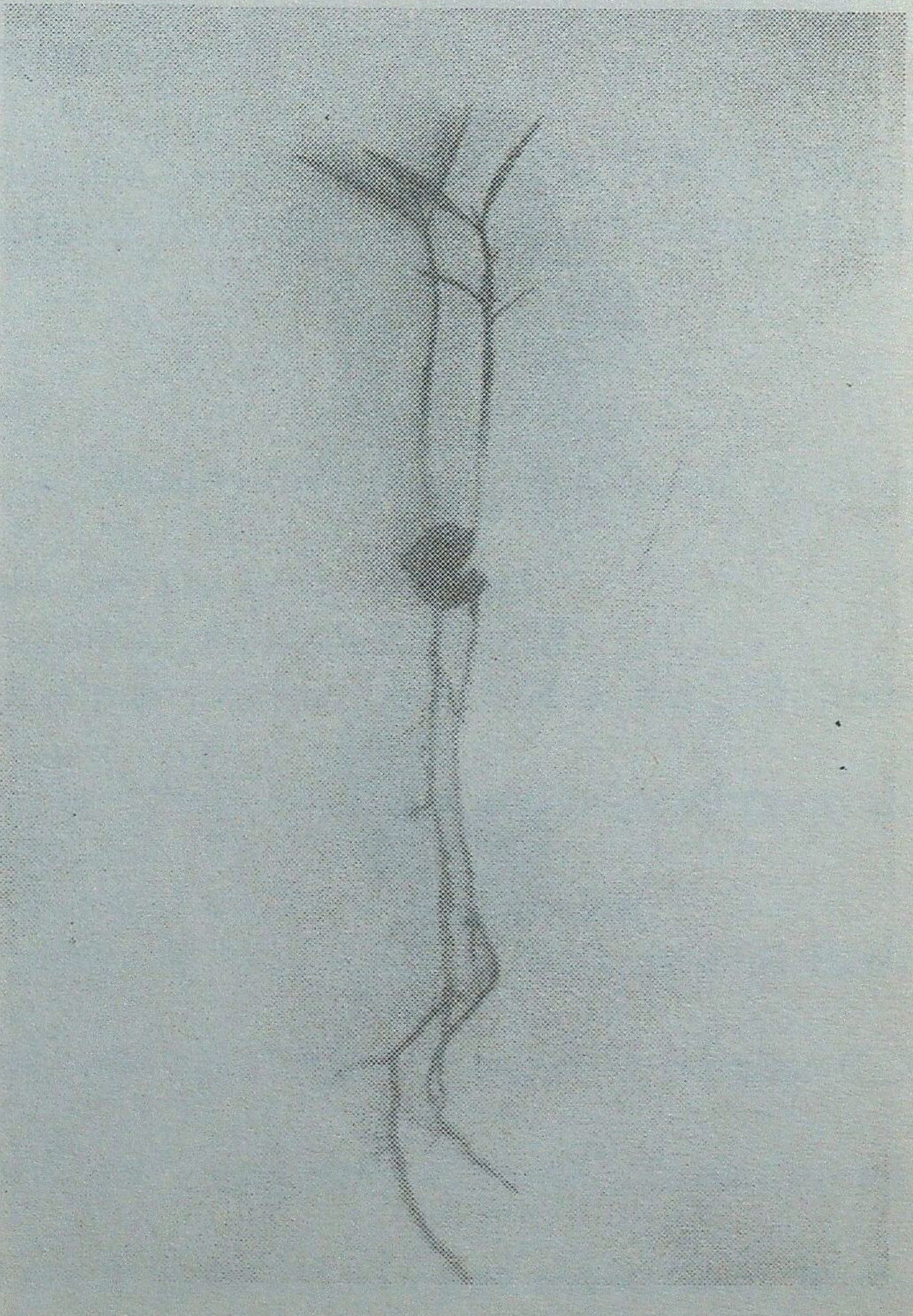
Polyembryony is a phenomenon of occurrence of more than one embryo in a seed resulting in development of more than one seedling from it (Maheshwari, 1974). Polyembryony, especially cleavage polyembryony is a common phenomenon in gymnosperms. In angiosperms, however, it is less frequent. Polyembryony has been reported for several native tree species, like *Aegle marmelos* (Yadav *et al.*, 1990). *Acacia nilotica* (Dobriyal and Bagchi, 1990; Adarsh Kumar *et al.*, 1991), *Azadirachta indica* (Singh *et al.*, 1995), *Bombax ceiba* (Venkatesh and Emmanuel, 1978), *Butea monosperma* (Shrivas and Bajpai, 1990), *Pongamia pinnata* (Mamta Purohit and Jamaluddin, 1987), *Pterocarpus marsupium* (Shrivas and Bajpai, 1990), *Commiphora wightii* (Gupta *et al.*, 1996) and *Tectona grandis* (Dabral, 1977). This paper reports the occurrence of polyembryony in *Syzygium cumini* and in *Vateria indica*.

Syzygium cumini (L.) Skeels (Myrtaceae)

Syzygium cumini is a large evergreen tree belonging to the family Myrtaceae. It occurs in India, Sri Lanka, Myanmar, Malaysia and Australia. In India it grows almost throughout, except in the most arid regions. The fruit of the tree is edible and this economically important tree species is sacred to Hindus and Buddhists (Troup, 1984).

S. cumini seeds collected from Thannissery in Palakkad District of Kerala State during July, 1998 were subjected to germination study. Of the 60 seeds sown, only three germinated, out of which, one

Fig. 1



Twin seedlings of *Syzygium cumini*

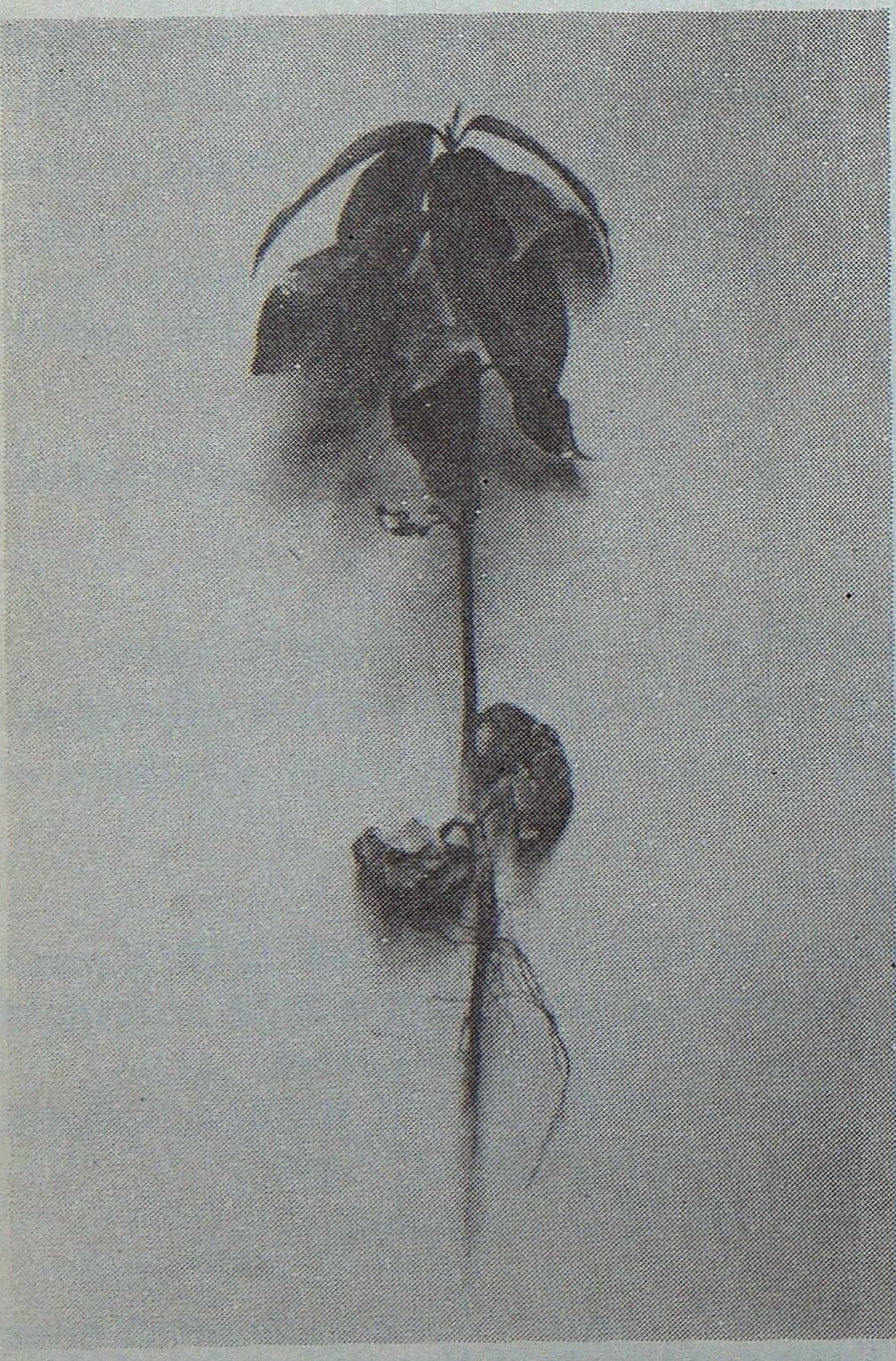
seed produced twin seedlings. The twin seedlings (Fig. 1) were independent, having separate tap roots. The seedlings were potted in the same polybags (22.5 cm x 17.5 cm), filled with potting mixture of soil, sand and compost (3 : 1 : 1); their further development was observed for 30 days in the nursery. The seedlings grew as healthy normal seedlings. These twin seedlings probably developed from twin embryos in the seed.

***Vateria indica* L. (Dipterocarpaceae)**

Malabar White Pine, *Vateria indica*, is a large evergreen tree occurring in West coast tropical evergreen and semi-evergreen forests of India. It is an economically important tree endemic to Western Ghats of India. The tree yields a useful oleoresin (Indian Copal) which is used for varnishing pictures and anatomical preparations, for making candles and ornaments. The seeds of the tree also yield vegetable butter, called 'Malabar tallow' or 'Vateria fat' or 'Piney tallow', which is used as a luminant, in confectionery and as a substitute for 'ghee'. The bark is also in demand for the manufacture of 'arak' and jaggery (Datta, 1988).

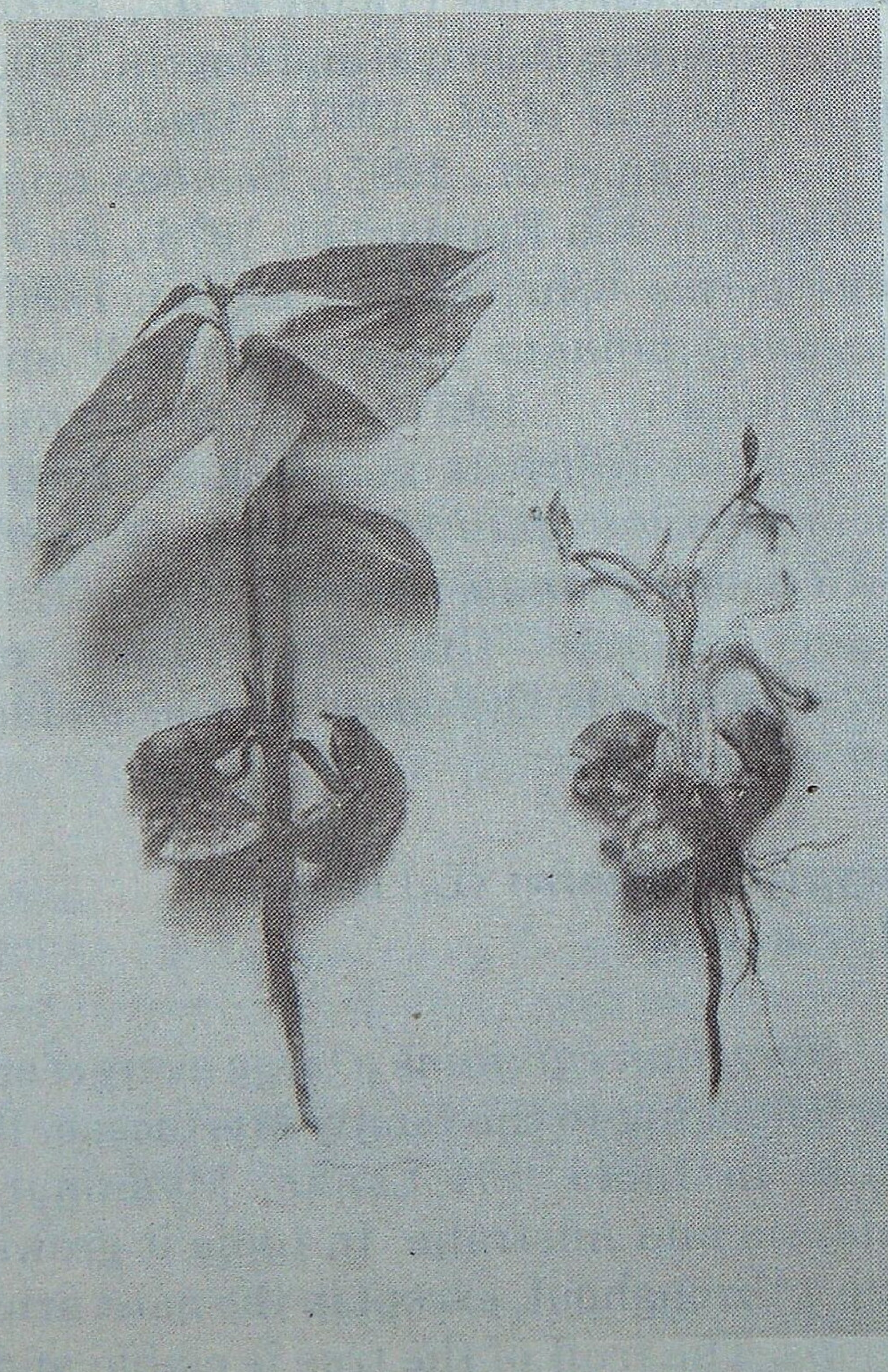
Mature fruits were collected from an avenue tree in Vellani (near Thriprayar) in Thrissur District, Kerala State during July 1998. Germination study was carried out using 100 seeds in four replications of 25

Fig. 2 a



Normal seedling of *Vateria indica*

Fig. 2 b



Polyembryonic seedlings of *Vateria ndica*

seeds each. Germination was hypogeal. Of the 84 germinated, three produced polyembryonic seedlings; two with twin seedlings and one with four seedlings (Fig. 2). All the polyembryonic seedlings were potted separately in polybags (22.5 cm x 17.5 cm) using the potting mixture of soil, sand and compost (3 : 1 : 1) and maintained in nursery. After twelve days, in the case of quadruple seedlings only one survived out of the four whereas in both the twin seedlings both the twins survived.

Application of polyembryony in breeding programmes

Polyembryony has much application in plant breeding and horticulture. Homozygous diploids can be raised from haploids. One can also obtain genetically pure plants by making use of adventive embryos. According to Maheshwari and Sachar (1963) polyembryony are of two types, i.e., true polyembryony and false polyembryony. In true polyembryony, the additional embryos arise within the embryo sac, either by budding or cleavage of the zygotic pro-embryo, or from the synergids and antipodal cells. The embryos may also originate from the cells of the nucleus or integument. On the other hand, in false polyembryony, supernumerary embryos may arise from different embryo sacs growing in the same nucellus or by fusion of two or more nucelli with independent embryo sacs. Production of adventive embryos may be autonomous or independent of the stimulus of pollination and fertilization (Kozlowski, 1972).

Acknowledgements

Authors are grateful to Dr. J.K. Sharma, Research Co-ordinator and Dr. K.K.N. Nair, Head, Botany Division, K.F.R.I. for valuable suggestions and comments on earlier versions of the manuscript.

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FOREST NOTES AND OBSERVATIONS

LEARNING AFFORESTATION THROUGH FOLLIES

"Water, water everywhere but not a drop to drink"; the more apt line would be : "Khair, Khair everywhere but not a single tree with Katha". Yes, these plantations have numerous trees of "Khair" (*Acacia catechu*) but there is hardly any content of 'Katha' in their heartwood. These large patches of plantations were raised in Singhbhum District in a big way, way back in the 1950s. It was new introduction of this species to this area, specially valuable for its 'Katha' content. The reason for its extension was obvious, as the extensive tracts of *Acacia catechu* in natural forest of Central and South-western Bihar had one of the highest content of 'Katha' and by its exploitation, the Forest Department used to earn considerable revenue.

The Gidhibera forest of Kandra Beat, Saraikella Range of Singhbhum bear the best testimony to the above statement. The plantations of *A. catechu* were raised here, sometimes in 1955-56 by late Hardayal Singh, a renowned forester who later became the first Director, Lac Development. In 1980-81, those trees had grown to attain girth of 15 to 20cm and were duly harvested by the senior author. But to our utter surprise the tree had no heartwood formation and naturally no 'Katha' could be extracted from such wood. So, it was a great economic failure for the Forest Department, which could not get any revenue from such venture as there was no other important use of *A. catechu* trees, except for 'Katha'. Still *A. catech* is conspicuously absent in Singhbhum region.

These experimentations tell us about pitfalls of introduction of new species for afforesting new tracts, without considering the various parameters in right perspective.

Similar is the episode about Shisham (*Dalbergia sissoo*) which was also tried at large scale in old Singhbhum District. The trees grew well in initial years but after 7 to 10 years, they started drying from the top.

Detailed analysis was made and results obtained were quiet startling. The details of the same appeared in the Report of Afforestation Review Committee in 1965. In most of the places where such failure due to "top drying" was reported, it was found that there existed a layer of lateritic pan (of 5cm or more in thickness) in the sub-soil. This "Lateritic pan" obstructed the root system of young plantation of *D. sissoo* resulting an its gradual death. These finding were further confirmed, when some plantations raised in Singhbhum and neighbouring Sub-division of Kharsawan had luxuriant growth of *D. sissoo*. The exploration of sub-soil showed that there was no lateritic pan underneath in this region. The culprit was identified as "Lateritic pan", which does not allow

D. sissoo roots to penetrate it in Singhbhum region by and large. This is the reason, why *D. sissoo* also is almost absent in this belt.

But the same "lateritic pan" could not hinder the growth of *Acacia auriculiformis* or "Acacia" or "Akasi" as its root could penetrate the "Lateritic pan" and thus grew unhindered. This is the reason for the extensive plantation and present survival in large tract of *Acacia auriculiformis* in South Bihar, South Bengal and Orissa, except those zones which are affected by the problems of frost in winters and 'loo' (Hot westerly winds) in summers.

Another important species of plantation forestry, Simal (*Bombax ceiba*) has excellent growth potential for Bihar. The two regions, North of Ganges and Southern tract consisting of Singhbhum District both have good soil and sufficient rainfall, besides conducive climate. Yet one hardly finds *B. ceiba* plantation in Singhbhum District despite this similarity. Whereas in North Bihar, it is doing exceedingly well, after the initiation made by the Forest Department. Encouraged by its success, many individuals and private companies like WIMCO and plywood manufacturers had gone for captive plantations in a large way. But the *B. ceiba* was affected by stem borer, which needed application of systemic pesticide to eliminate this. This problem could be tackled effectively in plantations of North Bihar but this could not be cure for Singhbhum District, where plantations raised were mostly amongst the jungle of hilly terrains, inaccessible tracts and this offered great difficulty in efficacious administering of any "systemic pesticide". The menace of the stem-borers rose to such level that it was thought prudent to abandon the plantation of *B. ceiba* altogether. After 1965, for all the practical purpose *B. ceiba* is not planted in Singhbhum tract of Bihar.

Similar is the story of 'Siris' (*Albizia* species) which could have proved to be very good plantation species but for its one drawback. The Chotanagpur and particularly Singhbhum offers good soil, adequate rainfall and conducive climate for the growth of *Albizia*. In fact all the plantations raised by the Forest Department till they were taken care of by the watchers, presented excellent picture of luxuriant growth. But by the end of first or second year or so when the cattle watchers and protection staff were withdrawn, it was immediately browsed by the deer species and blue bulls. The Sambhar (*Cervus unicolor*) in particular relished the palatable young shoots/twigs of new plantations. For this reason, this species has also been included in forbidden list of Afforestation Wing.

But in case of Bamboo (*Dendrocalamus strictus*) plantations, the experiment carried out in Bihar offered excellent results. Earlier the conventional way of raising the plantation of bamboos was by rhizomes and it was practised all over the country. But it was the Bihar Forest Department which showed that the seedlings raised by seeds of bamboos can be split into a number of plantlets and same could be grown in mass scale. This new technology not only proved to be cheap but huge planting material for large area could be prepared unlike the limitation offered by the low availability of conventional rhizomes. This could also avoid the problem of "gregarious flowering" usually associated with Rhizome plantations.

Extensive tracts of plantation raised by this new technology attracted the

attention of foresters from far and wide. The success of these plantations could be gauged from this fact that at present it is difficult to achieve the harvest target of 12,000 to 15,000 MT of bamboos per year from the whole forest of Bihar. Whereas the farmers alone of Chakulia locality of Singhbhum District only, produce bamboo to the tune of 50,000 to 70,000 MT/year, from their farmlands. A lot of this bamboo produced is exported to States like Delhi, Haryana and Punjab etc. after meeting the local demand. The success story of bamboo plantation attracted the senior foresters from all over the country. A special aircraft chartered for this purpose in 1964, brought the top forestry experts of the country, who were attending the Conference organized by Central Board of Forestry, to Chakulia Singhbhum Distt./Parasnath (Giridih Distt.) etc. of Bihar and these experts were deeply impressed by the indigenous technology and resultant growth. The experts who were attending Forestry Conference at Dehra Dun, took this technology to their respective States and it revolutionized the bamboo cultivation scenario of the country. But in Bihar, subsequent unfortunate development like excessive biotic interference in the growth became the major bottleneck. The nutritious shoots were greedily devoured by the cattle/goats. Even more damage to it was caused by the locals who had great liking for its tender rhizomes (locally called 'Karil'). The exploitation of 'Karil', treated as delicacy in South Bihar, virtually proved instrumental in decimating the bamboos from natural forests. The things have come to such a pass that the State, once capable of supplying 80,000 to 100,000 MT of raw bamboo to three paper mills of the State besides supplying it to paper mills outside the State, has no worthwhile outturn. All these paper mills have been closed down. What a pathetic end of a glorious chapter in afforestation history of Bihar !

In this list of afforestation experiment, it would be interesting to mention how deceptive, some terms could be. The terms are calcareous (meaning, full of 'kankar', or pebbles of lime) and Calcimorphic (the soil, which has calcium available in the organic form). This subtle difference between the two types of soil, when not understood, proved disastrous in introducing in 'citrus trees'. The experts were proved wrong who claimed that the Chotangapur can also yield as good 'Santra' as of Nagpur. The Chotangpur region of Bihar is by and large geologically of Gondawana formation, except a part of Palamau and Gaya, which are of Vindhyan formation. In all this region, the soil is by and large calcareous except few patches of Calcimorphic soil. One such patch is Chiyanki (Near Daltonganj), which due to good plantation of citrus, led to the establishment of Citrus Research Station of Govt. of Bihar, there. This station is still continuing, which started in late 1920s. But the efforts of introduction of citrus to the calcareous area (confusing it with calcimorphic soil) in other parts of the region were doomed, as it could not thrive in calcareous soil.

These titbits of plantation experiments involving different species can be analysed in a very philosophical background. The senior author of this article, who had just joined the forestry profession in Bihar, along with some of his senior colleagues could not resist asking Dr. S.K. Seth, the Chairman of Plantation Evaluation Committee, which was on an inspection visit to the State in 1978. When pointed out that all the efforts of conservation of natural forest are failing and are not proving effective and even

plantation strategy is proving extremely difficult to tide over this crisis, what could be the possible solution ! Dr. Seth replied sarcastically (as it appeared) that it was due to lack of general will for conservation amongst general masses and it will only come when all the forests of the country are destroyed. He supplemented his statement by quoting the example of England, where once all natural forest had been destroyed. Maybe Dr. Seth's belief was of extreme pessimism formed under the prevailing circumstances. Other witness to this revealing were Shri S.N. Banerjee the then Conservator of Forests. How prophetic his words were, when we find that with all the attention and resources (both human and material), how difficult it is to protect and conserve the left over forests. Innovative afforestation perhaps could be only one of the few options left with the foresters who are facing the onerous challenge of conservation with virtually their back against the wall.

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From the Indian Forester - One Hundred Years Ago

THE
INDIAN FORESTER

December, 1900 (pp. 616-617)

The Coppicing of Unprotected Forests

In the Central Provinces there are certain rules laid down by the Local Government, regarding the cutting of trees in private (malguzari) forests, and one of these states that all trees that are felled shall be cut flush with the ground. As this method of cutting differs from that usually adopted by the natives (who, so as to save themselves the trouble by stooping when using their axes, fell their poles at 2 feet 6 inches or 3 feet from the ground), it is not an unfrequent occurrence for orders to be issued by the Deputy Commissioner on the report of the Forest Officer, that, in forests when cutting has taken place after the ordinary native method, the stumps shall be re-cut flush with the ground, and in the event of non-compliance a fine is exacted.

That trees in forests protected from fire and from grazing should be coppiced at ground-level, except in the case of areas subject to frequent inundations, I readily admit. Strong coppice shoots are thus produced, and these often develop independent roots, and thus the ensuing volume of timber will be greater as the life of the tree will be longer than in cases in which coppicing is carried out at a distance of from 2 to 3 feet from the ground. But is this method of coppicing in unprotected forests always wise? In this district of Raipur in which I am, the malguzari forests are situated on land which, compared with the greater part of the surrounding land under cultivation, is high, the annual rainfall is about 50 inches, and there is no fear of inundations. But these forests are always heavily over-grazed, and, on the fall of the leaves in February and March, are burnt either purposely to produce fresh shoots of grass for grazing or accidentally by mohwa gatherers and others.

The fires do practically no damage to trees above a few inches in girth, as they run along the ground burning only the shed leaves and the short grass stubble which is too woody for the cattle to eat; but the damage they do to coppice shoots springing from the ground is enormous; every shoot that comes in the way of a fire is killed, and the only chance for the escape of a shoot growing up, 'as ordained by Government,' is the absence of dead leaves lying around the stool or the accidental turning of the fire. The case, when coppicing is done at some distance from the ground, is different. Very often these are burnt too, as inflammable matter has a way of accumulating at the base of trees, but if there is only the ordinary layer of dead leaves and stubble around the stump for the fire to consume, the coppice shoots escape unburnt, and the proportion of these shoots that escape being burnt must be much greater than when coppicing flush with the ground is undertaken.

Such shoots, too, are less heavily grazed than others nearer the ground, as the topmost shoots will be nearly always out of reach of goats and of cattle too. Another point is, that it is in only rare cases that malguzari forests are called upon to produce large timber, the main local demand being for poles of 12 inches to 18 inches girth, and for this reason this great advantage of low-level coppicing (*i.e.* the productions of strongly-rooted trees which will develop into big timber) is not needed.

It appears to me, therefore, that in forests over which no protection from fire and over-grazing exists, and in which annual fires, the nature of which I have already remarked on, take place, more would be gained by allowing the owners to cut their poles at some distance from the ground in the way that they were accustomed to do, than by enforcing the orders of Government, that all trees when felled should be cut flush with the ground in the hope that big timber, for which there is little demand, may be produced.

Raipur
Central Provinces

A.M. LONG

Form IV

1.	Place of Publication	-	New Forest, Dehra Dun.
2.	Periodicity of its Publication	-	Monthly
3.	Name of Printer	-	S.K. Arora, MBA
	Whether citizen of India	-	Yes
	Address	-	Print World, Anekant Place, Rajpur Road, Dehra Dun
4.	Publisher's Name	-	Rajesh, I.F.S.
	Whether citizen of India	-	Yes
	Address	-	P.O. New Forest, Dehra Dun
5.	Editor's Name	-	G.S. Rawat, I.F.S.
	Whether citizen of India	-	Yes
	Address	-	P.O. New Forest, Dehra Dun
6.	Names and addresses of individuals who own the Newspaper and partners or shareholders holding more than one per cent of the total capital	-	Board of Management Indian Forester, P.O. New Forest, Dehra Dun.

I, Rajesh, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Sd/- Rajesh
Signature of Publisher

LETTER TO THE EDITOR

To,
The Hony. Editor,
Indian Forester,
P.O. New Forest,
Dehra Dun (U.P.)

Sub : Problems/Challenges facing the Indian Forest Service Cadre

Sir,

I have gone through the article captioned above by Shri A.K. Goyal appearing in your esteemed journal of June, 2000.

Shri Goyal in his article narrated problems/challenges facing IFS cadre which may be said to be the tip of the iceberg. There are some more deep rooted and serious problems/ challenges facing the cadre. To my mind forestry is primarily a technical service created by Government for the sound management of forests in the interest of environment and watershed management and to a lesser extent to meet the needs of people. In actual practice, however, the service starts toeing the line dictated by political masters from time to time be it settling encroachments or several rights and concessions in respect of grazing or on forest produce which are allowed to be continued on forest land inspite of the fact that the forests are no more in a condition to allow the continuation of such practices. M.S. Choudhary Commission set up by Govt. of India long time back, recommended the discontinuation of these rights and concessions and the said report is gathering dust in Govt. of India records.

Let us take the present condition of State trading of forest produce from time to time in Madhya Pradesh. Trading is a highly commercial activity and its introduction has made the forestry staff at all levels carry out commercial activities to which they are not trained and oriented and as such fail miserably. A publication of M.P. Forest Department "Four Decades of Madhya Pradesh Forestry" shows that production in respect of timber, fuelwood, bamboo, NTFP have fallen by one fourth to one fifth of its earlier figures after State trading was introduced. Net forest revenue which in 1961-62 constituted 16 per cent of State revenue, constituted only 8 per cent in 1994-95. Further there is complete failure in State trading so for the objectives with which it was started.

Further in view of their involvement in commercial activity forestry services have largely failed to protect the forest from illicit and excessive fellings and removal, forest fires, illegal grazing, encroachments and wildlife protection. Forest rights and concessions

and removal of headloads of fuelwood has resulted in large scale devastation of forests. Forest mafia gangs are active and it is a problem to book them in the law courts as per the statement of Minister of Forests recently.

Government of India (MoE&F) promulgated Wildlife Protection Act, 1972 and Forest (Conservation) Act, 1980 with noble ideal of protection of wildlife and forest. The State Governments have over the years considered the Forest (Conservation) Act, 1980 as an obstacle to the development process of their States and have been pressing for the repeal of this Act or diluting it completely. The hardcore of forestry service in the MoE&F, Govt. of India fizzle out all proposals of greening 50 per cent of forest wastelands by agencies other than government when they themselves are incapable of doing anything about them.

A recent development is the supremacy of highest legal authority of the land to impose stringent measures for the protection and conservation of forests and wildlife. This has exposed the actions of executive and technical forestry authority of the country over a period of fifty years.

In my view the problems/challenges facing the IFS are much more deep rooted than visualised by Shri Goyal. With the present trend and inspite of tall talk of Joint Forest Management, the forests and wildlife in the country do not face a bright future in years to come.

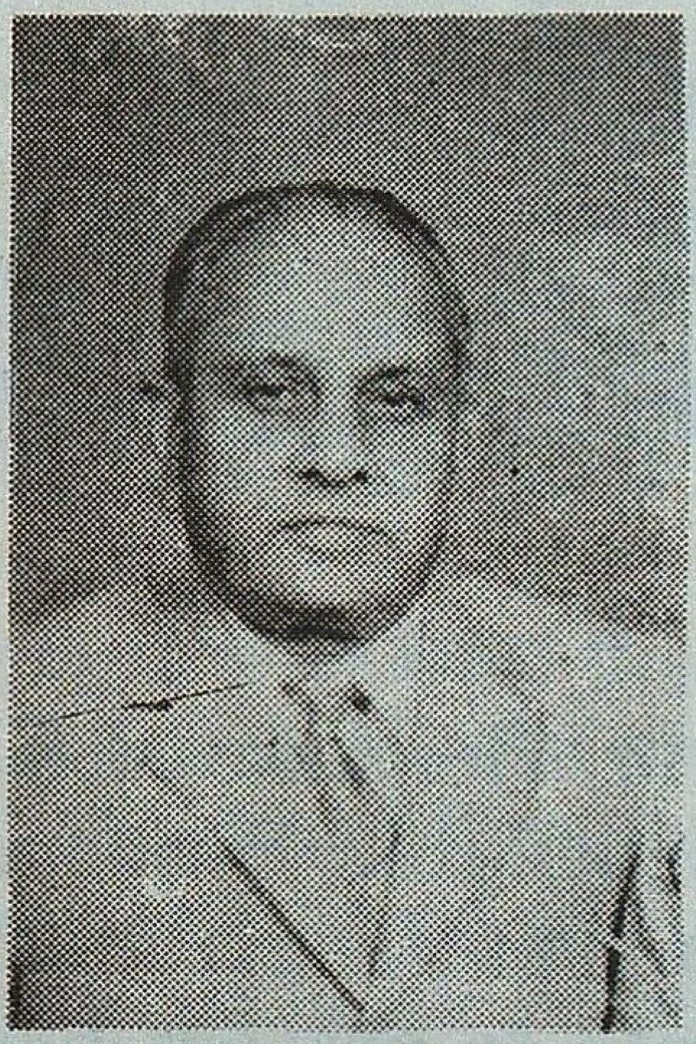
Yours faithfully,

Sd./- D.G. Sharma, IFS (Retd.)
E-1/181, Arera Colony,
Bhopal (Madhya Pradesh)

OBITUARIES

(I)

S.K. Vashishtha
(1926 - 2000)



Shri S.K. Vashishtha died in Indore on 6th September 2000 after prolonged illness. He was 75.

Shri Vashishtha belonged to 1949-51 batch of Indian Forest College. He joined the Forest Service in Ex. Madhya Bharat region and by sheer hard work and dedication rose to the rank of Chief Conservator of Forests from which post he retired. During his long meritorious service, he held many important assignments with distinction.

Shri Vashishtha as his surname would have you believe was an unassuming person with simple habits. He believed in doing his duty without trying to throw his weight around. He remained away from any controversy throughout his service. He was very particular about forest protection and would not tolerate any subordinate being careless in this regard.

Shri Vashishtha leaves behind his family and a large circle of friends to mourn his death. May his soul rest in peace.

P.M.R.

(II)

N.K. Joshi
(1929-2000)

Shri N.K. Joshi died in his sleep rather suddenly on 18-8-2000 in Jhansi, where he had settled down after retirement from service.

After doing his post graduation in Botany from Sagar University, he joined the 1951-53 batch of Indian Forest College. He was picked up fairly early as a promising officer who needed grooming for higher posts in the Department. He held many important assignments within technical and administrative fields and rose to the rank of Director General of Forests of M.P. in 1986. He retired from service after availing six months extension in service in June, 1988.

Shri Joshi was an intelligent and highly experienced officer. He believed in leading a team and expected each and every one to play his assigned role. Once he had judged a person he was not averse to seek his opinion or to accept a suggestion made to him. He was a man of likes and dislikes but tried hard to prevent his prejudice overriding his objective assessment.

His wife died of Cancer in 1993 and it can be said that he never really got over the feeling of loneliness thereafter. The news of his sudden death reached his friends and colleagues in Bhopal very very late and that too through a chance meeting with his sister in Delhi. It is such an irony of fate that such a well known person should have died without his friends and colleagues being aware of it for well over three weeks.

Shri Joshi leaves behind a host of friends and colleagues to mourn his death. May his soil rest in peace.

P.M.R

(III)

S.C. Agrawal

(1.08.1928 - 18.08.2000)

The Indian Forest Service fracternity will learn with a sense of sorrow about the sad demise of Shri S.C. Agrawal after a massive heart attack at Indore. He was 72.

After a brilliant academic career which he culminated with an M.Sc. in Botany, Shri Agrawal taught as a Lecturer in Botany and Horticulture at Government College, Jobner (Rajasthan) from 1949 to March 1951. In April 1951 Govt. of erstwhile CP and Berar selected him for State Forest Service. After obtaining AIFC Diploma from Indian Forest College, Dehra Dun, he was posted as ACF at Balaghat in April 1953.

He was promoted to DCF in 1961 and worked in the capacity of DFO Rewa, East and West Bastar, Khandwa, South Betul and Sagar Forest Divisions. He also prepared Working Plan for Narsinghpur For. Divn. and was State Forest Utilisation Officer in which capacity he made very valuable contribution for working out raw material forest resources of the State. From 1970 to 1975, he was on deputation with Govt. of India under Preinvestment Survey, with postings at Jagdalpur and Nagpur.

In December 1975, he was promoted to Conservator of Forests and worked in that capacity in Sagar and Hoshangabad circles. He was sent on deputation to Industries Department and worked as Industrial Advisor Audyogik Vikas Nigam (M.P.) and Controller of Forest Works at Nepa Paper Mills till 1983. In 1983 he was promoted to Additional CCF and continued as Controller of Forest Works at Nepa Paper Mills. In 1984 he was promoted to CCF and worked as Managing Director Minor Forest Produce Federation (M.P.), from which post he retired on 31.07.1986.

Shri Agrawal's finest contribution was in the capacity of FUO, Preinvestment Survey Govt. of India, Audyogik Vikas Nigam and as Controller of Forest Works Nepa Paper Mills and Managing Director MFP Federation which highly valued by the Government.

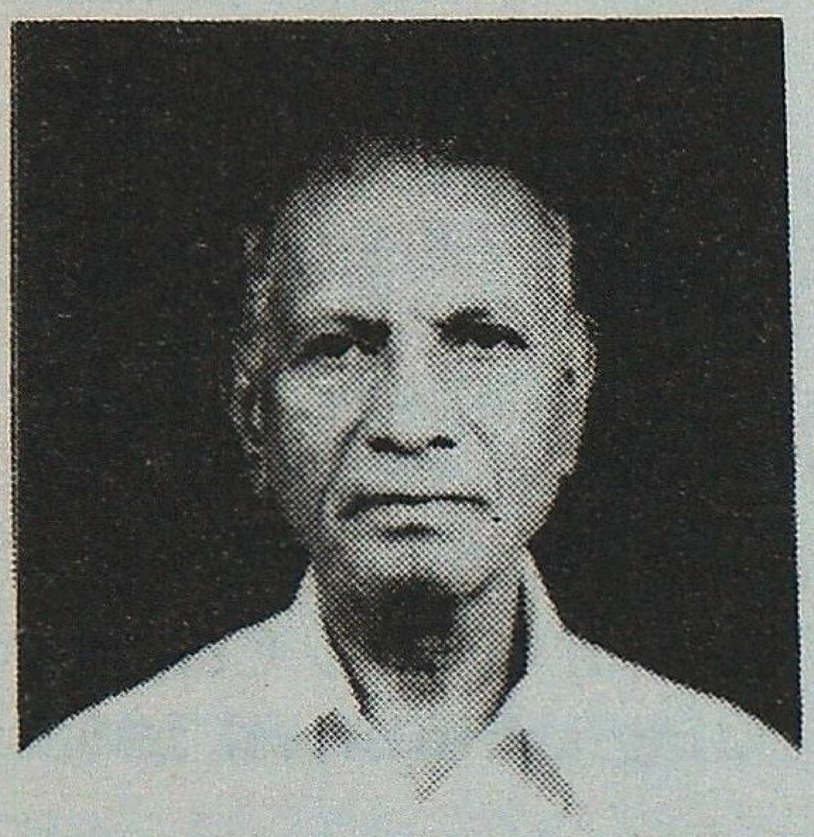
Shri Agrawal went on six months Forestry training to Europe in 1963. He was a person of great dedication and perfection in all jobs entrusted to him. Both he and Mrs Agrawal were of amiable and religious disposition and were an asset to the people and places wherever they were posted. After retirement Shri Agrawal was associated with social work and was Chairman of Brij Chikitsa Sanstha, Mathura which runs a big hospital and several leading educational institutions.

He is survived and fondly remembered by his wife and four sons and large number of friends and admirers. May his soul rest in peace.

D.G.S.

(IV)

S. Panduranga Reddy
(08.12.1922 - 07.09.2000)



Shri Panduranga Reddy, a retired member of the Indian Forest Service, passed away due to cardiac arrest on September 7, 2000 at Huntsville, Alabama (U.S.A.) while he was on a visit to his daughter. He was 78.

Shri Sandadi Panduranga Reddy, born on December 8, 1922 in a small village in Mahbubnagar District, belonged to a family of agriculturists. After his early education in the village, he studied upto Intermediate in the Osmania University College of Science at Hyderabad.

Shri Panduranga Reddy was selected in 1945 for appointment as Forest Ranger in the erstwhile State of Hyderabad. After completion of the training in the Indian Forest Rangers College at Dehra Dun in 1945-47, he joined the Hyderabad State Forest Department and worked as Ranger for about eight years. He was promoted to the State Forest Service in 1955 and worked as Assistant Conservator of Forests attached to three divisions. After States' Reorganisation in 1956, he was posted as Sub-Divisional Forest Officer at Khammam. He then held independent charge of Divisional Forest Officer in about eight districts of the State of Andhra Pradesh covering all the three regions of the State, namely Rayalaseema, Telangana and Coastal Andhra. He was promoted to the Senior Scale of the Indian Forest Service in 1963 and Supertime Scale of I.F.S. in 1979. He retired as the Conservator of Forests, State Trading Circle, Hyderabad on December 31, 1980.

Shri Reddy was an able, experienced, amiable and industrious officer; versatile in several disciplines of forestry. He was a pioneer in successfully raising Red Sanders plantations in Chittoor District.

Shri Panduranga Reddy is survived by his wife, son and four daughters, all well settled in the medical profession.

May his soul rest in peace.

K.B.R.

GAZETTE NOTIFICATIONS

GOVT. OF INDIA GAZETTE

The President, Indian Council of Forestry Research & Education Society is pleased to appoint Shri R.P.S. Katwal, I.F.S., Chief Wild Life Warden, Govt. of Tamil Nadu to the post of Director General, Indian Council of Forestry Research & Education, Dehra Dun in the scale of Rs. 22,400-525-24500, with effect from the date he assumes charge of the post.

Dr. J.K. Rawat, IFS (HR:72) Director, Forest Research Institute, Dehra Dun is appointed as Director, Forest Survey of India, Dehra Dun in the scale of 22,400-525-24500 with immediate effect.

ANDHRA PRADESH

The following Assistant Conservators of Forests are appointed by promotion temporarily to the post of Deputy Conservator of Forests (State Cadre) in the scale of pay of Rs. 9600-300-9900-350-11650-450-13900-525-16525 with immediate effect. The Officers on promotion will continue in the posts presently held by them in the cadre of Deputy Conservator of Forests.

Sl.No.	Name	Place of working at present
	Sarvashri :	
1.	P. Adivappa	Deputy Conservator of Forests, Planning & Extension Division, Khammam
2.	Mohd. Ibrahim	Deputy Conservator of Forests, Planning & Extension, Vizianagaram
3.	Bh.Basivi Reddy	Divisional Forest Officer, Logging Division, Giddalur
4.	P.V. Raja Rao	Deputy Conservator of Forests, Planning & Extension Divisional, Kurnool
5.	K. Venkaiah	Silviculturist, Rajahmundry
6.	J.S.N. Murthy	Divisional Forest Officer, Medak
7.	P.V. Ramana Reddy	Deputy Director, Hyderabad Urban Development Authority, Hyderabad (on deputation)
8.	B. Anand Mohan	Director, Urban Development Authority, Visakhapatnam (on deputation)
9.	A.Bharat Kumar	Deputy Conservator Forests, Planning & Extension Division, Vijayawada

10.	Ch.A.V.D.Prasanna Kumar	Divisional Forest Officer, Vigilance-1, Office of the Principal Chief Conservator of Forests, A.P. Hyderabad
11.	M. Ravi Kumar	Divisional Forest Officer, Flying Squad Division, Visakhapatnam
12.	T.P.Thimma Reddy	District Manager, Housing Corporation, Nalgonda (on deputation)
13.	K.J.C. Wesley	Divisional Forest Officer, Flying Squad, Hyderabad
14.	Mohd.Jalaluddin Akbar	Deputy Conservator of Forests, Office of the Conservator of Forests, T&E Circle, Hyderabad
15.	T. Sudhakar	Divisional Forest Officer, Flying Squad Division, Karimnagar
16.	Dr. G. Narsaiah	Divisional Forest Officer, Flying Squad Division, Medak
17.	D. Nagabhushanam	Divisional Forest Officer, Flying Squad Division, Guntur
18.	K. Lohitasyudu	Divisional Forest Officer, Logging Division, Rajahmundry
19.	B. Shrinivas	Divisional Forest Officer, Wild Life Management, Warangal
20.	N. Chandra Mohan Reddy	Director (Urban Forestry), Municipal Corporation of Hyderabad (on deputation)

Shri C.P. Vinod Kumar, ACF working as DFO, Flying Squad, Nirmal is transferred and posted as Divisional Forest Officer, Giddalur in the existing vacancy.

Shri P. Ashok Kumar, ACF is posted as Assistant Conservator of Forests (FCA) in the Office of the Principal Chief Conservator of Forests, Andhra Pradesh, Hyderabad vice Shri L.N. Goud, ACF, retiring from Government service on attaining the age of superannuation on the A.N. of 31-8-2000 A.N.

Shri D. Ravinder Reddy, ACF/Deputy Conservator of Forests, Planning & Extension Division, Sangareddy is transferred and posted as DFO, Flying Squad Division, Khammam in the existing vacancy subject to the condition that no TTA etc., is allowed.

Shri V. Ranga Rao, ACF, who is waiting for posting orders, is posted as DFO, Flying Squad Division, Rajahmundry in the existing vacancy.

Shri C.E.V. Prasada Reddy, ACF, who is waiting for posting orders, is posted as Deputy Conservator of Forests, Planning & Extension Division, Sangareddy in the vacancy caused due to transfer and posting of Shri D. Ravinder Reddy, ACF, as DFO, Flying Squad Division, Khammam.

The services of Shri P.S. Shrinivasa Sastry, ACF are withdrawn from the TTD, Tirupathi and he is posted as Deputy Conservator of Forests, Planning & Extension Division, Mahabubnagar in the existing vacancy.

The services of Shri P. Subrahmanyam, ACF, are placed at the disposal of Tirumala

Tirupati Devasthanams, Tirupati initially for a period of one year from the date of assumption of the charges of the post on the usual terms and conditions of deputation.

Shri G. Gurunathudu, ACF, is posted as Sub-Divisional Forest Officer, Bhadrachalam North of Bhadrachalam North Division in the existing vacancy.

Shri Sardar Iqbal Singh, ACF/Sub-Divisional Forest Officer, Luxettipeta of Mancherial Division as Sub-Divisional Forest Officer, Manuguru of Paloncha Division vice Shri Abdul Aleem, Assistant Conservator of Forests, transferred.

Shri Abdul Aleem, ACF is posted as Sub-Divisional Forest Officer, Luxettipeta of Mancherial Division in the above vacancy.

Shri M. Mohan Rao, ACF, waiting for posting orders is posted as Sub-Divisional Forest Officer, Hyderabad of Hyderabad Division vice Shri M. Narasimha Reddy, Assistant Conservator of Forests, transferred.

On transfer, Shri M. Narasimha Reddy, ACF is posted as Sub-Divisional Forest Officer, Etumagaram (Wildlife) of Wildlife Management Division, Warangal in the existing vacancy.

WEST BENGAL GAZETTE

The Governor is pleased to promote the following Forest Officers :

Shri G.B. Thapliyal, IFS, now Addl. PCCF (Planning & Development) to the grade of PCCF on promotion and post him as the PCCF (Wildlife & Bio-Diversity) until further orders and with effect from the date of his assuming the charges.

Shri V. Rishi, IFS now Addl., PCCF (Research & Working Plan) to the grade of PCCF on promotion and place his services at the disposal of the West Bengal Forest Development Corporation Ltd. for posting as Managing Director on deputation, until further orders and with effect from the date of his assuming the charges.

Shri V.P. Singh, IFS now on Central Deputation as CCF (Central), Bhopal (MP) but opted for reversion, to the grade of an Addl. PCCF, on promotion and reversion to the State Govt., and post him as Addl. PCCF (Research & Working Plan) until further order and with effect from the date of his assuming the charge vice Shri V. Rishi, IFS promoted to the grade of PCCF.

Shri A.K. Ghosh, IFS, now CCF (Wildlife) to the grade of an Addl. PCCF on promotion and post him as the Addl. PCCF (Planning & Development) until further order and with effect from the date of his assuming charge vice Shri G.B. Thapliyal, IFS promoted to the grade of PCCF.

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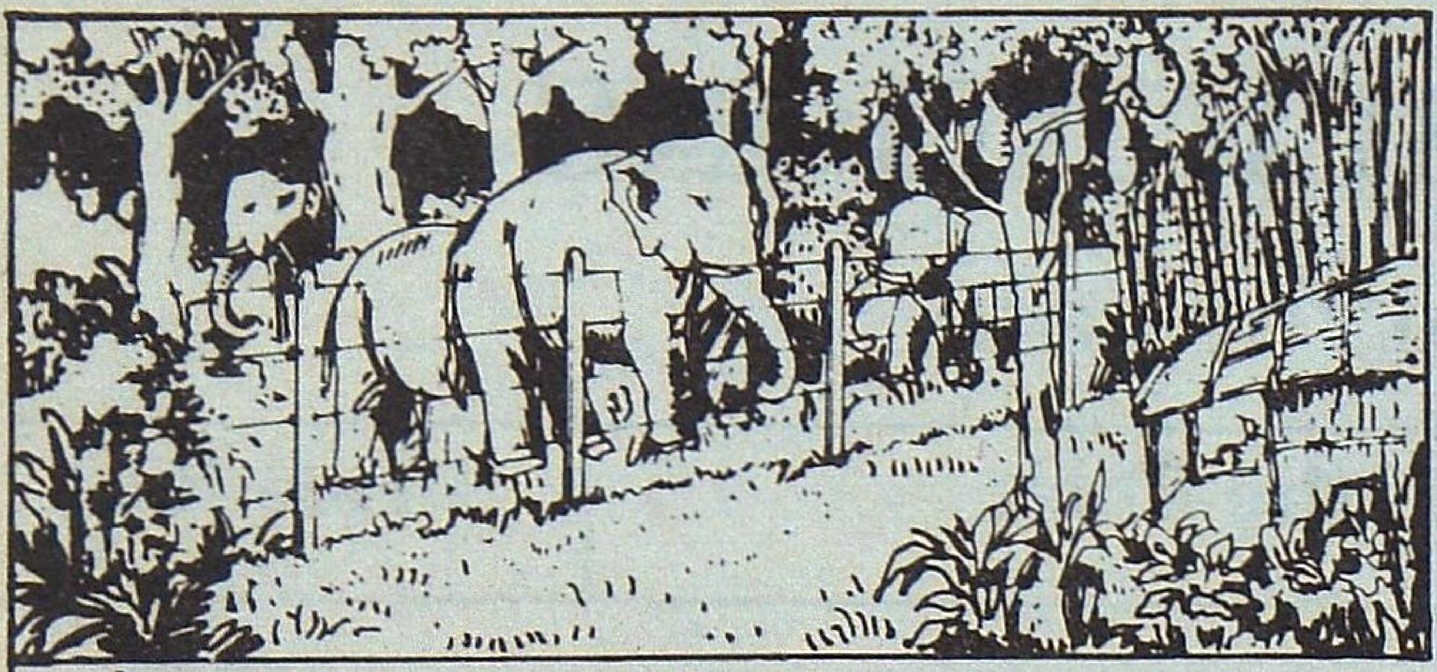

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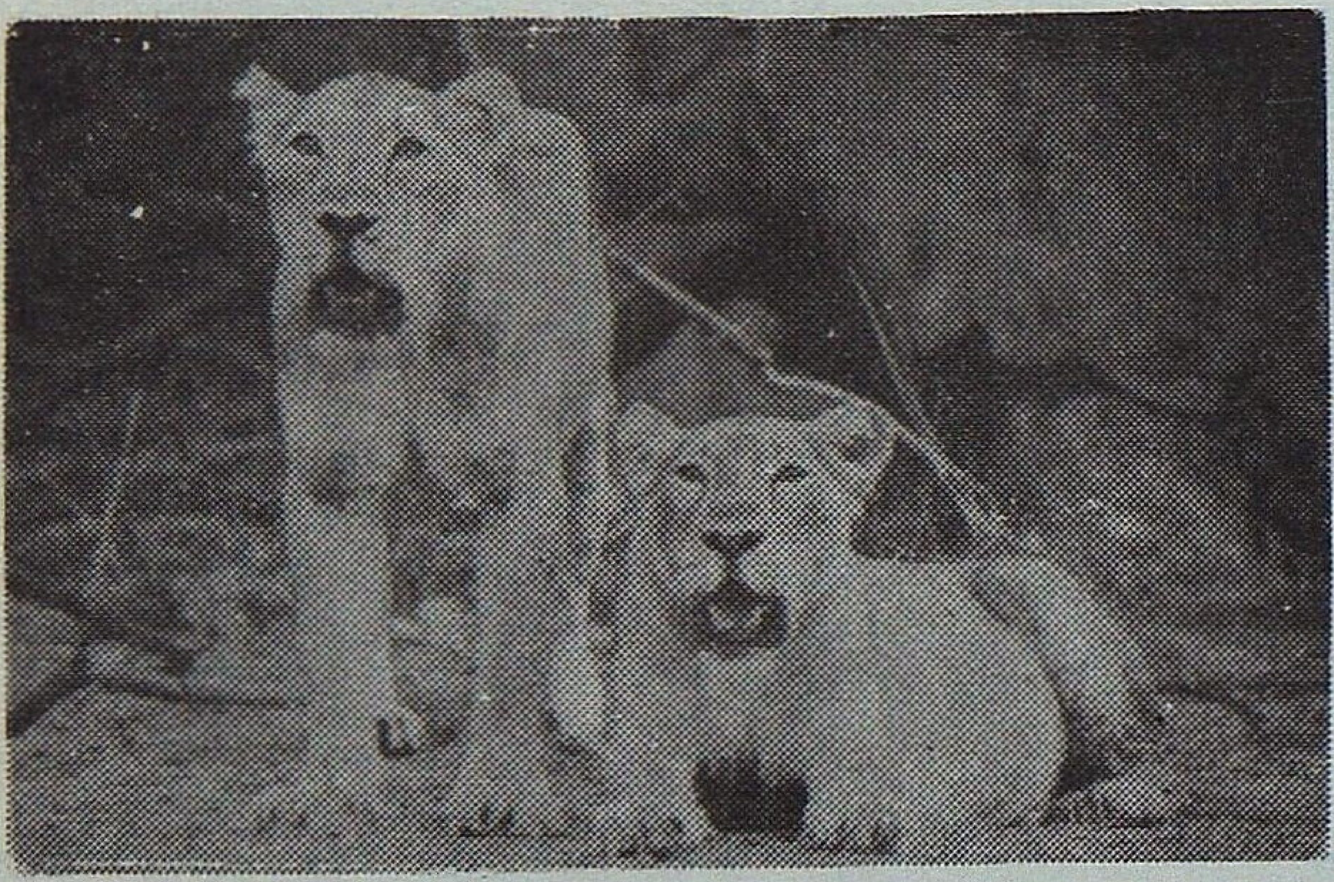

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BEST VISITING TIME : 15TH JUNE - 15TH OCTOBER

For More Information Contact

Deputy Conservator of Forest
Nanda Devi National Park
Joshimath (Chamoli)
Ph : 22179

Joint Director
Nanda Devi Biosphere Reserve
Gopeshwar (Chamoli)
Ph : 52497

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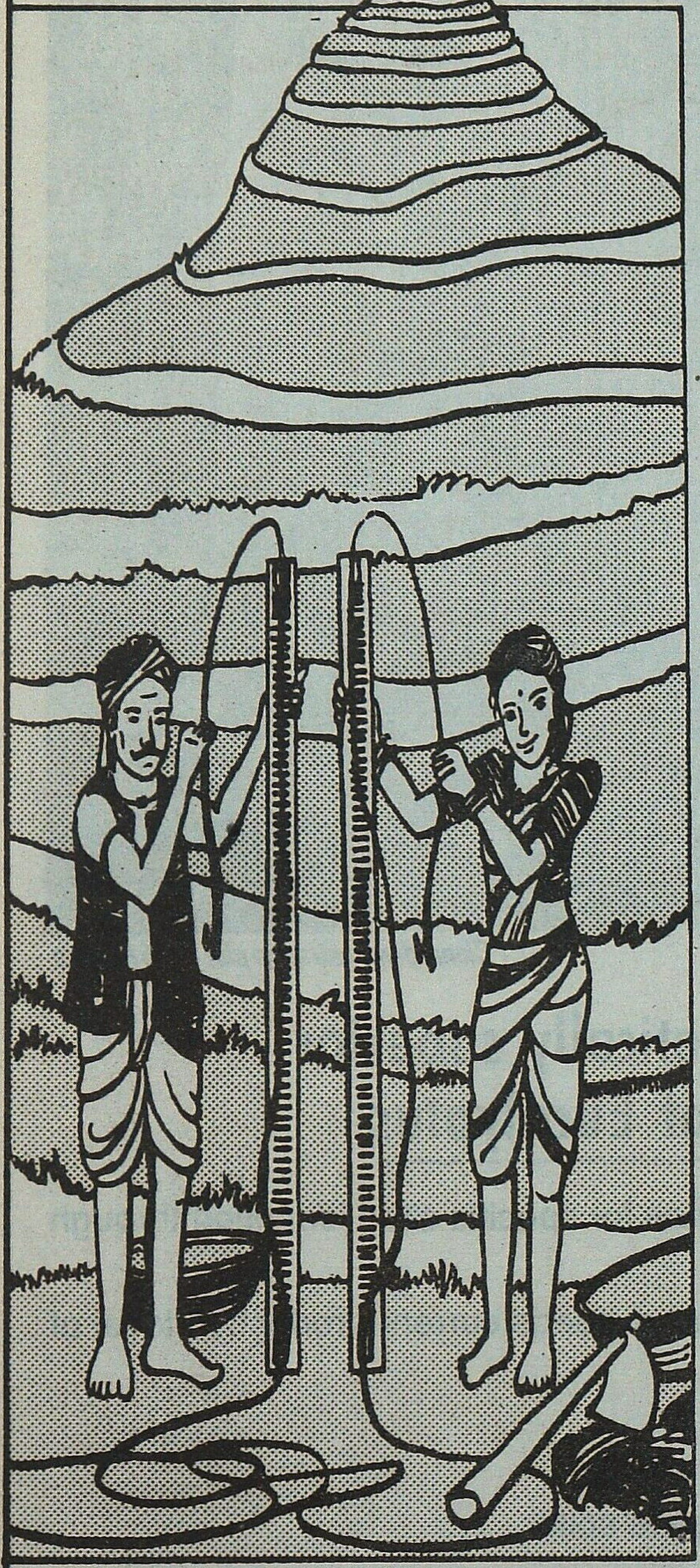

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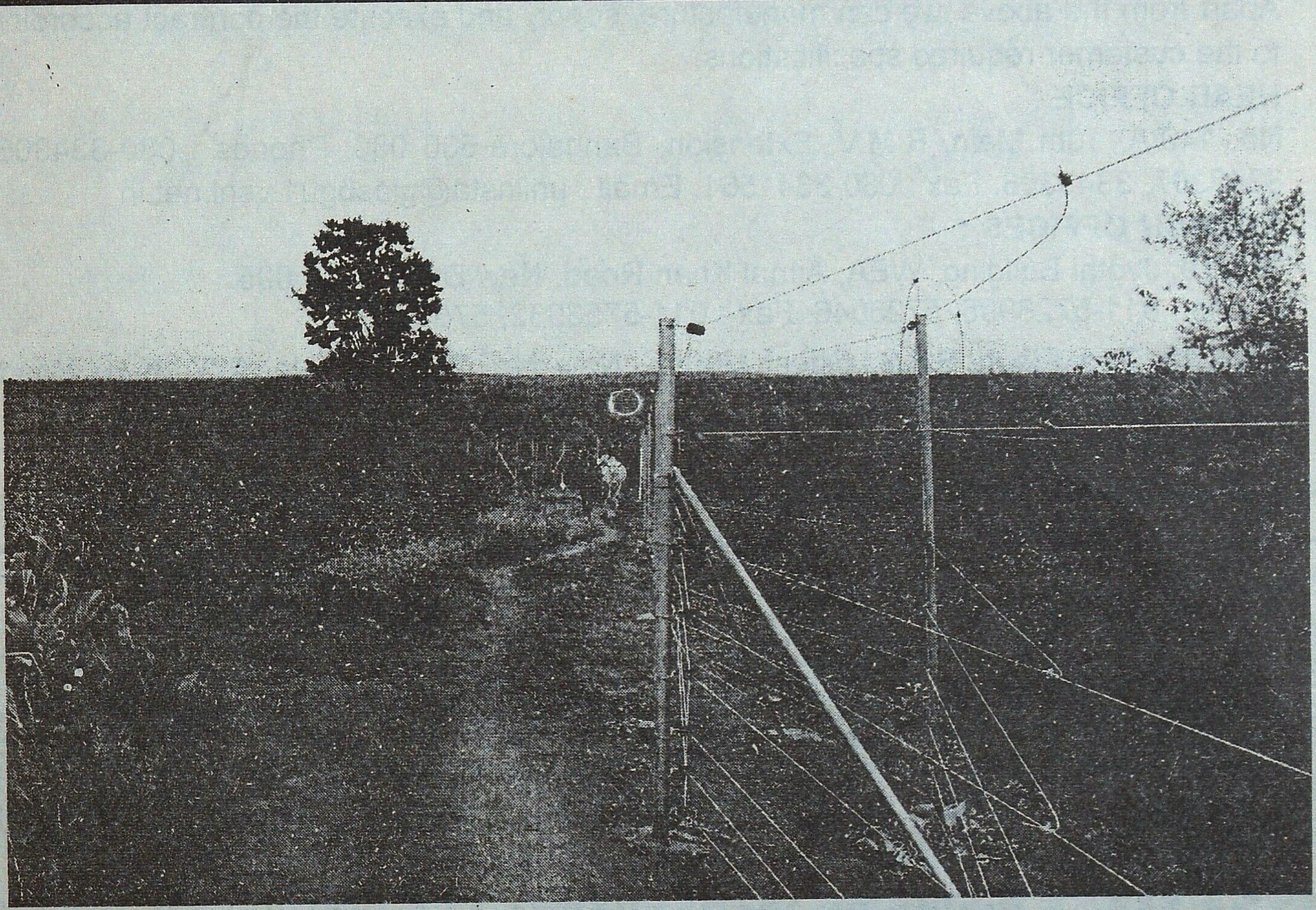

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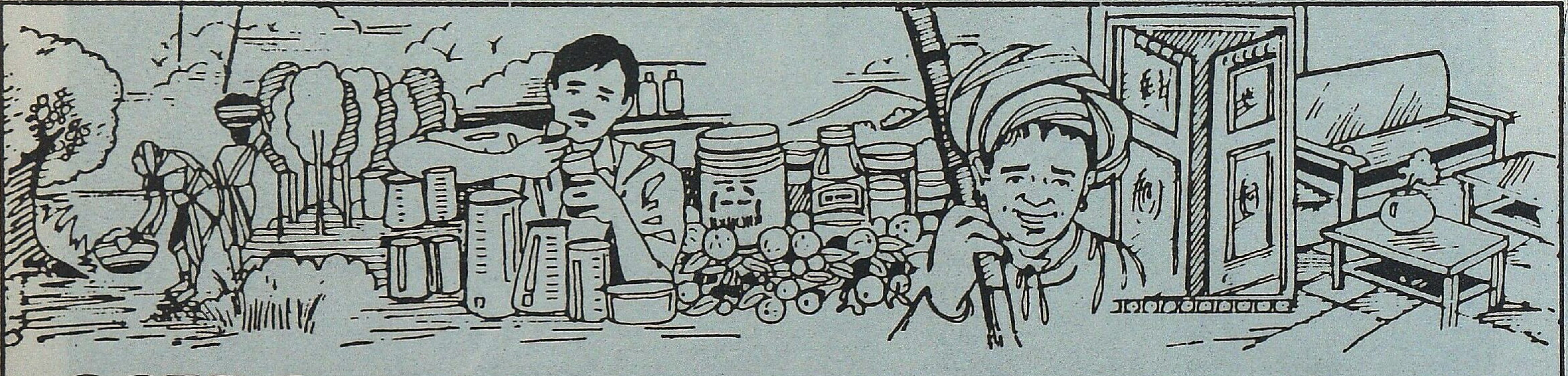

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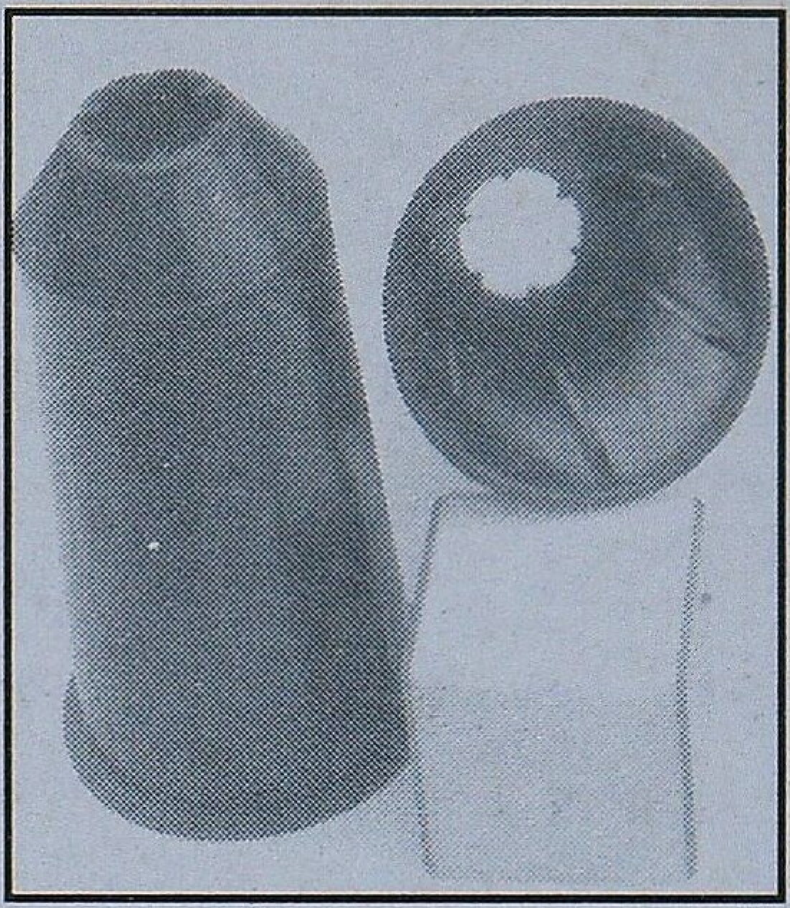

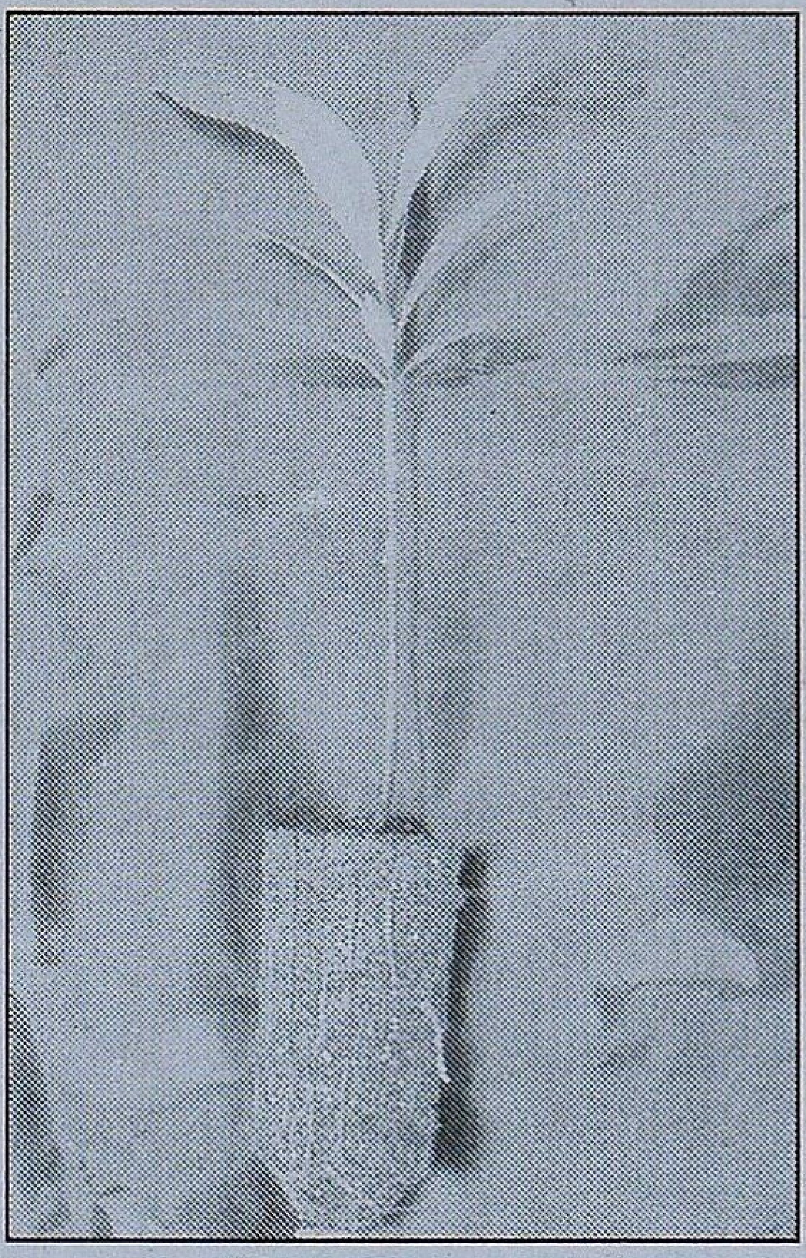

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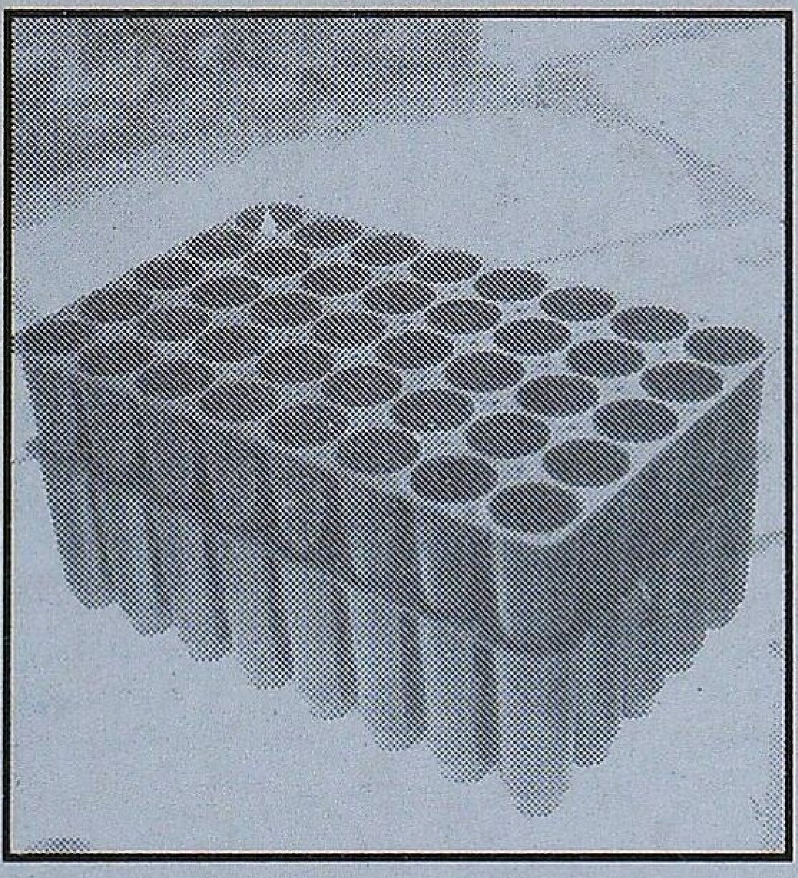

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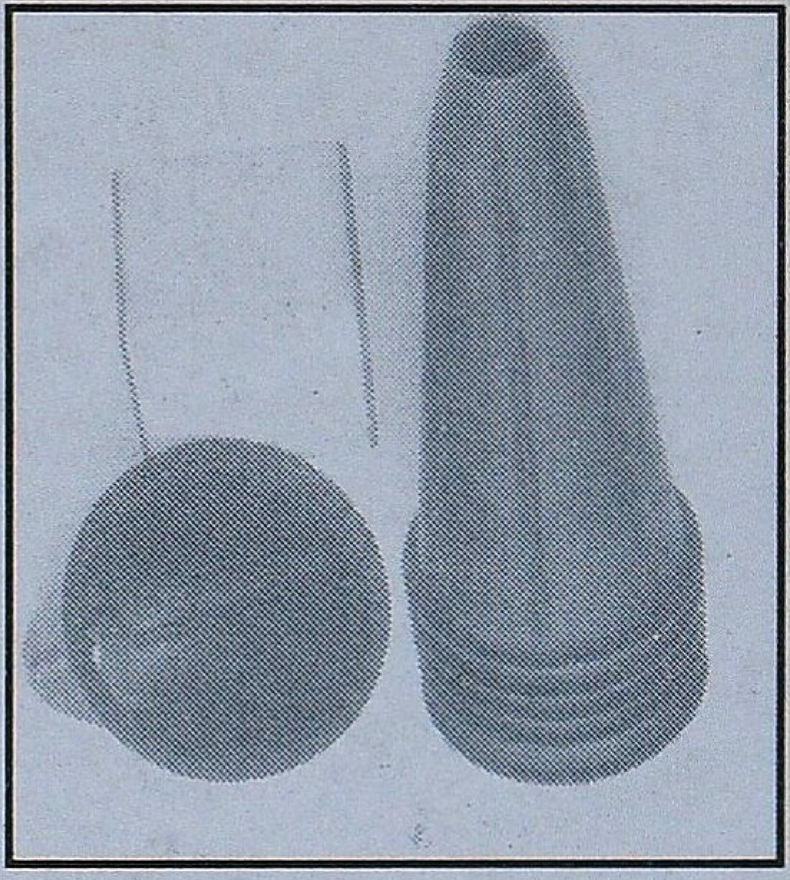

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